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SEGMENTATION OF THE OVUM, WITH ESPECIAL REFERENCE TO THE MAMMALIA.

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(Concluded from page 481.)

DURING all these early stages the cells (segmentation spheres) are naked, *i.e.*, without any membrane; the nuclei, when not in karyokinetic stages, are large, clear, and vesicular; the yolk granules are small, highly refractile, and more or less nearly spherical; they show a marked tendency to lie in the cell half-way between the nuclear and the edge of the cell, or when the cells are large, around the nucleus and at a little distance from it.

It is at about this stage that the ovum passes from the Fallopian tube into the uterus, where it dilates into what is known as the *blastodermic vesicle*. This dilatation is due principally to the multiplication and flattening out of the cells of the outer layer, and of course involves the expansion and consequent thinning of the zona pellucida, (compare Figs. 8 and 13.) The inner mass meanwhile remains passively attached to one point on the circumference of the vesicle, (Fig. 11, *i.m.*) By this process the thin fissure between the inner mass and the outer layer becomes a considerable space, (Fig. 13).

The blastodermic vesicle continues to expand, and in the rabbit and mole there is a corresponding enlargement of the tubular uterus at the point where the vesicle is lodged. "It is

clearly impossible for the delicate walled ovum to expand in the form of a vesicle, and distend the uterine walls by virtue of the growth of its cells; it must be therefore concluded that it obtains some support. This support is rendered from within. The vesicle contains a transparent fluid, the nature of which I am only sufficiently conversant with to say that, after a treatment with alcohol, a white precipitate is present in the vesicle. It is equally evident that this fluid can only have been obtained from the uterus, and that it is present within the vesicle at a very considerably greater pressure than in the uterus itself. Such a condition is caused by means of the cells of the wall of the vesicle; this function being performed against a pressure which is greater on their inner than on their outer side, exactly as the cells of the salivary glands are known to act. The uterine fluid is secreted by glands present in great numbers in the uterine tissue, and is poured through their open mouths into the cavity of the uterus. There is every probability it has nutritive

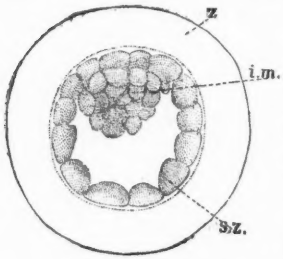

FIG. 11.

Young blastodermic vesicle of a mole, after Heape: *M*, mucous envelope; *z*, zona pellucida; *i m*, inner mass; *en*, entoderm; *s c*, segmentation cavity.

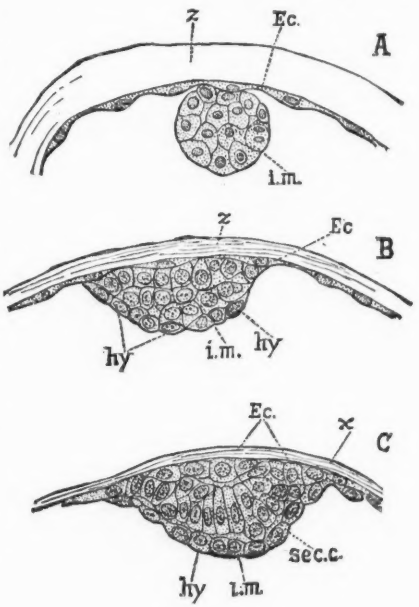

FIG. 12.

Sections through the inner mass of the blastodermic vesicle of the mole at three successive stages: *z*, zona pellucida; *s z* subzonal layer; *i m*, inner mass.

qualities, since it is thence taken up into the cavity of the embryonic vesicle, which eventually functions as a yolk-sac, in the walls of which embryonic blood-vessels ramify."—*Heape.*

The inner mass (Fig. 11, *i.m.*) does not at first grow much, and retains its rounded form, becoming, at least in the mole, nearly globular. (Fig. 12, A.) The inner mass subsequently flattens out, becoming lens-shaped, thinner, and of larger area. (Fig. 12, B.) It continues spreading laterally, and separates into

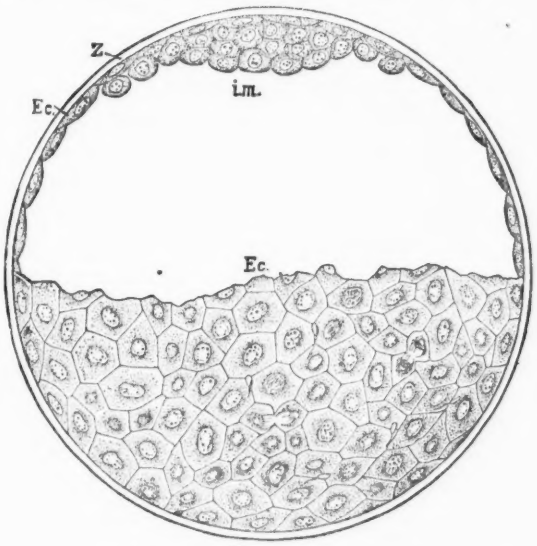

FIG. 13.

Ovum of rabbit ninety-four hours after coitus, after van Beneden: *en* subzonal epithelium (entoderm); *z*, zona pellucida; *i m*, inner mass of cells.

three distinct layers. The ovum now consists of a very thin zona pellucida (Fig. 13, *z*), close against which is a single layer of thin epithelial cells, *En:* at one pole this layer is interrupted by a lens-shaped mass, *i.m.*, formed by three layers of cells. These three layers were first clearly described by E. van Beneden *9*, and have been since figured by him *10;* van Beneden identified these three layers with the three permanent germ-layers, which do not arise until later. Rauber, however, showed that both the

outer layers enter into the formation of the ectoderm, while the inner layer is concerned in the production of the permanent entoderm; the outermost layer Rauber terms the Deckschicht Lieberkühn *31a*, and others have since then confirmed Rauber's results.

Homologies of the mammalian blastodermic vesicle.—We have so little accurate information concerning the details of the formation of the blastodermic vesicle, that any interpretation must be tentative. I still consider, however, the view which I brought forward in 1885 (*Buck's Reference Hdbk. Med. Sciences*, I., 528), as the most satisfactory, and preferable to the similar explanation advanced independently and simultaneously by Haddon, *20*, and reproduced by him briefly in his "Practical Embryology," 47–48. F. Keibel, *27*, advocated similar interpretations two years later, but without quoting Minot or Haddon. I regard the subzonal epithelium as the entoderm, and the inner mass of cells as the primitive blastoderm or ectoderm: by so doing the parts can be readily and exactly homologized with the parts in the frog's ovum, as will be evident at once if the diagram (Fig. 14) of the mammalian vesicle be compared with the section of a segmented amphibian ovum, (Fig. 4).

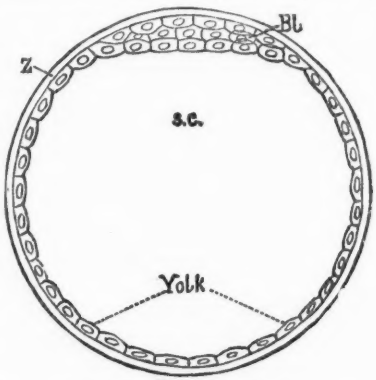

FIG. 14.

Diagram of a segmented mammalian ovum: *z*, zona pellucida; *Bl*, primitive blastoderm; *s c*, segmentation cavity; *yolk*, layer of cell representing the remnant of segmented yolk.

The primitive blastoderm *Bl.* or ectoderm consists of several layers of cells rich in protoplasm; below it is the large segmentation cavity, *s.c.*, relatively much larger in the mammalian than in the amphibian ovum. At its edge the primitive blastoderm joins the entoderm *yolk*, which in amphibia is a large mass, in mammals only a single layer of cells. Now, we know that the ancestors of the higher mammals had ova with a large amount

of deutoplasm, which in the course of evolution has been lost, so that in the ova of the Placentalia there is very little yolk material. We know, further, that the readiness of cellular divisions depends on the amount of yolk; hence when the yolk is lost, we should expect to find the entoderm, which, as we have seen, is derived from the vegetative substance of the ovum, to be represented by relatively small cells. If we imagine the number of entodermic cells in the frog's ovum (Fig. 4, *Yolk*) reduced, their connection with the primitive blastoderm and their character as a continuous layer being preserved, we obtain at once the characteristic arrangement of the mammalian blastodermic vesicle, (Fig. 14.) The homology here established is further confirmed by the coarse net-work of protoplasm in the cells of the outer layer of the vesicle (Ed. van Beneden, *10*), suggesting at once the meshes which have been emptied of their deutoplasm. Adam Sedgwick, *43*, has shown that in the ova of *Peripatus capensis* the yolk matter has been lost, though abundant in other species of the same genus, and the coarseness of the protoplasmic net-work is preserved as evidence of the granules formerly present. This observation serves to confirm the view I have suggested as to the significance of the wide-meshed reticulum of the cells of the mammalian sub-zonal layer, (Fig. 14, *Yolk*.)

The disposition of the animal pole in the ovum before segmentation also conforms to the homologies here advocated. It will be remembered that the protoplasm of the animal pole extends far into the ovum, and is enveloped by a cup (deutoplasm zone) of the substance of the vegetable pole. Hence when the animal pole forms cells they lie as an inner mass, (Fig. 11, *i.m.*)

If Minot's view be adopted, then the ectoderm lies within the entoderm at a certain stage of development, for the one cell which retains, as shown in Fig. 8, the connection of the ectoderm with the exterior, is subsequently overgrown by the outer layer of cells (van Beneden, Heape). There is then a complete inversion of the germ layers in all (?) placental Mammalia. In most cases the inversion is temporary; the inner mass, as described above, flattens out, and probably flattens out *inside* the outer epithelial layer; if this is the case, then the external layer of the

lens-shaped mass (Fig. 12, B and C, *im*) is really entoderm; this layer is Rauber's *Deckschicht*, which, as already stated, usually disappears, leaving the true inner mass, or permanent ectoderm, to form part of the surface of the blastodermic vesicle, so that, with the exception of the reduction in the dimension of the entoderm, the relations are the same as in other vertebrate ova.

The inner layer of the flattened inner mass gives rise to the entoderm, and this at first sight appears to be conclusive evidence against the homology here drawn between the inner mass and the primitive ectoderm of other vertebrates. The same thing was formerly supposed to occur in the blastoderm of other vertebrates, but it is now known that the entoderm is added from another source to the under side of the primitive blastoderm or ectoderm, and though we possess no exact information whatever as to the origin of the entodermic cells under the primitive blastoderm of the Mammalia there is no reason to assume that they arise in a manner fundamentally different from that typical of other vertebrates. We may therefore dismiss this objection. The origin of the entodermic cavity I hope to discuss on another occasion.

Planes of Division during Segmentation.—The plane of the first divisions determines those of the subsequent divisions, and also of all the axes of the embryo.[1] It is itself determined by the position of the long axis of the first amphiaster or nuclear spindle, to which it is at right angles. It, therefore, is a matter of great interest to ascertain what factors determine the position of the first spindle, or, in other words, the axis of elongation of the segmentation nucleus. So far as at present known there are two factors: I. Relation to the axis of the ovum; II. Position of the path taken by the male pronucleus to approach the female pronucleus. The axis of the ovum is fixed before impregnation. It passes through the center of the animal and that of the vegetable pole. Usually the nuclear spindle which leads to the for-

[1] In certain cases, notably in birds as described above, the segmentation is irregular; and it is, therefore, not known yet whether the scheme of arrangement of the cleavage planes here given can be applied to all ova or not. We may say, however, that the scheme is the primitive one, from which any modifications arose phylogenetically. The best discussion is by A. Agassiz and Whitman, *I*, 34–41.

mation of the polar globules has its long axis coincident with that of the ovum, hence the point of exit of the polar globule marks one end of the ovic axis. *The first amphiaster or spindle is always at right angles to the ovic axis.* This, however, leaves the meridian plane undetermined. Roux, *39*, from a series of interesting experiments on frog's ova, concludes that the plane is fixed by the path of the spermatozoon. So far as I know this idea was first suggested by Selenka, in 1878, in his paper on "The Development of *Toxopneustus variegatus*." Compare also Mark, *32*, p. 500. In the frog's egg the path of the male pronucleus is marked by a line of pigment, as was first described by van Bambecke, *4*, p. 65, and has been well figured by O. Hertwig, *25a*, Pl. V., fig. 4. The pigment renders it easy to ascertain the position of the male road, even after the first cleavage of the ovum. This Roux has done in sectioned ova, and from experiments and observations reaches this result: *The long axis of the first segmentation spindle lies in a plane which passes through the axis of the ovum and the path of the male pronucleus.* If Roux's conclusion is confirmed, it will become of fundamental importance. Yet there must be other factors which can at least replace the male pronucleus in this special role, since the development of pathenogenetic ova, in which there is no male pronucleus at all, is equally determinate. It is probable that the distribution of the protoplasm is the real cause determining the position of the nucleus; thus in oval eggs the spindle lies in the direction of the long axis. It is quite probable that if the male pronucleus has the effect ascribed to it by Roux, it produces it indirectly by altering the distribution of the protoplasm within the ovum; that such alteration takes place is indicated by the occurrence of the male aster.

That the first cleavage plane is determined by relations existing in the unimpregnated ovum has been suggested by O. Schultze in consequence of his finding the germinal vesicle lying excentrically in the eggs of the brown frog. Schultze suggests that the first plane passes through the ovic axis and the excentric nucleus. Roux, Biol. Col., VII., 420, maintains that this suggestion is set aside by his own observations cited above. For further discus-

sion see Schultze's short note, *42*, and Roux's rejoinder, *9*. I think the question whether the first cleavage plane is determined by the ovum's structure or not is still an open one.

As already stated, in the primitive segmentation, both invertebrate and vertebrate, the second cleavage plane is at right angles to the first, and also meriodional, while the third plane is at right angles to both the first and second, and therefore equatorial. In some meroblastic vertebrate ova this regularity is entirely lost.

Differentiation of the ectoderm and entoderm.—As already pointed out the essential feature of segmentation is the unlikeness of the cells produced; the manifold variations in the process of segmentation depend chiefly on the amount of yolk.

Minot, in 1877, *33*, first established the generalization that *in all animals the ovum undergoes a total segmentation during which the cells of the ectoderm divide faster and become smaller than the cells of the entoderm.* Compare Fig. 15. There are, however, a small and, I think, diminishing number of cases, where the process of segmentation is imperfectly understood, and which cannot yet be shown to conform to this generalization. "All the known variations in the process of segmentation depend merely upon: 1. The degree of difference in size between the two sets of cells; 2. the time when the difference appears; 3. the mode of development, whether polar or by delamination,[2] either of which may or may not be accompanied by axial infolding. In gastropods, planarians, calcispongæ, gephyrea, annelida, fish, birds, and arthropods the difference is great and appears early. In echinoderms, most

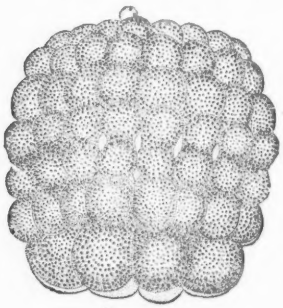

FIG. 15.

Ovum of *Amphioxus lanceolatus* during segmentation; stage with 88 cells, x 280 diams., after B. Hatschek. One pole is occupied by large entodermal, the other by smaller ectodermal cells.

[2] There is not a single satisfactory description known to me of the process of the so-called delamination and I feel a very great skepticism as to its being an actual occurrence. It is certainly at most a very rare and probably secondary modification of segmentation. It does not occur among vertebrates.

cœlenterates, some sponges, in nematodes, amphibians, etc., it is less marked and appears later.

In most cases the entodermic cells are very decidedly larger and less numerous than those of the ectoderm. This distinction is obviously necessary on account of the mutual relations of the two primitive layers. The ectoderm has to grow around the entoderm, which it can do only by acquiring a greater superficial extension; this the ectoderm accomplishes by dividing very quickly at first into small cells. After the entoderm is fully enveloped it may then continue to grow until its superficies is much greater than that of the outer layer, within which, however, it still finds room by forming numerous folds; thus is gradually reached the condition in the higher adult animals, where the intestine sometimes has an enormous surface, but is, nevertheless, contained in body-walls covered by ectoderm presenting much less surface. It is, therefore, only during the early stages of segmentation that we find the entoderm expanding more slowly than the ectoderm.

The terms *holoblastic* and *meroblastic* are applied to ova according to their manner of segmentation. The first is employed for those ova in which there is either very little or only a moderate amount of yolk, so that the whole of the ovum splits up into distinct masses (cells) which enter into the composition of the embryo. The second designates ova with a very large amount of yolk, so that while the protoplasm from which the ectoderm arises divides rapidly into distinct cells, the entodermal portion merely develops nuclei at first, with the result that while one portion of the egg is "segmenting," another portion (the entodermal) remains unsegmented, so far as the external appearances are concerned. Eggs, then, with much yolk undergo the so-called partial segmentation; hence the adjective *meroblastic*.

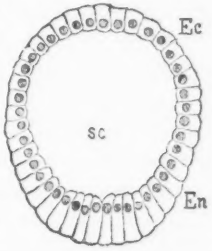

FIG. 16.

Blastula stage in the development of *Echinocardium cordatum*, after Selenka.

Whatever the exact mode of segmentation, there results always the same type of organization, to which Minot has applied the

term *diaderm;* it is characterized by consisting of two plates of cells, differing in character, joined at their edges (ectenal line), and surrounding a central segmentation cavity: the two plates or laminæ are the two primitive germ-layers, the ectoderm and entoderm. The earliest form of the diaderm is that known as the *blastula*, as Haeckel has felicitously named the first larval form of the lower animals. In the blastula we have a simple epithelial vesicle, the cavity of which is the large segmentation cavity (Fig. 16); the epithelial layer is one cell thick and divided into two regions, the one composed of smaller cells is the ectoderm, *Ec*, and the other, of larger cells, is the entoderm, *en*. This stage occurs with sundry modifications in a great many invertebrates. These modifications are due principally to the increase in the size of the entodermic cells, which, as already pointed out, results from the increase of the yolk matter in the ovum. Thus in many mollusks the entodermic cells are very large, and at first, few in number, (Fig. 17). By a still further modification the cellular yolk is replaced by a mass rich in deutoplasm, but not divided by cells, while at the same time the segmentation cavity is reduced by the invasion of the yolk mass. This is well exemplified in the ova of many arthropods, (Fig. 18). We have in this case the blastula type still evident, although the entoderm has at this stage no trace of its epithelial structure. In vertebrates we have the additional modification that cells are several layers deep in the ectoderm, and primitively in the entoderm also,—compare the section of the frog's ovum (Fig. 4). In certain forms, as we have seen, the entoderm is not

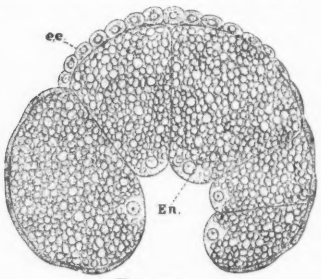

FIG. 17.

Blastula stage in the development of Natica; after Bobretzky.

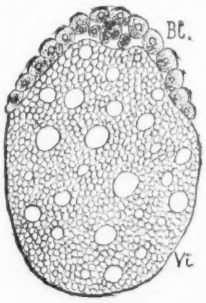

FIG. 18.

Section of the ovum of *Oniscus murarius;* after Bobretzky. *Bl*, blastoderm: *Vi*, vitellus or yolk representing the entoderm.

divided into discrete cells, but remains one mass; this is the case in elasmobranchs and the amniota, but in the highest amniota (Placentalia) the yolk is lost and the entoderm is again represented by a single layer of cells (Fig. 13).

It seems to me evident that *the first step of development in the segmenting ovum is the differentiation of the two germ-layers, ectoderm and entoderm, resulting in the diaderm stage.* Diaderm is a term preferable to blastula, because the latter is applicable strictly only to a special larval form, while the former is a general term which refers to the essential differentiation at this stage. It is important to remark that the two layers are distinct in the diaderm or blastula stage; it is often erroneously affirmed that the blastula consists of a *uniform* layer of cells, part of which subsequently becomes the entoderm.

The segmentation cavity comprises the whole space between the entoderm and ectoderm; it is very early invaded by cells produced from the two primitive germ-layers. These cells are in vertebrates of many kinds, and enter the segmentation cavity at various periods. It is customary to group the cells which enter early into this cavity under the common name of *mesoderm*, and to consider them as a third and distinct germ-layer. For convenience we may adopt this custom, for, to a certain extent, the mesoderm of authors is a separate germ-layer, but it by no means includes all the tissues which occupy the space between the two primitive germ-layers. As the space between the entoderm and ectoderm is always homologous with itself it follows that the entire room between the epithelium (entoderm) of the digestive tract and its appendages on the one side, and the epiderm on the other, is homologous with the segmentation cavity.

The mesoderm of authors comprises three tissues: (1), free wandering cells (*mesamœboids*); (2), embryonic connective tissue or cells connected together by processes (*mesenchyms*); (3), epithelium, which forms two or more separate sacks. The origin of the mesoderm and the relations of the three tissues it contains do not fall within the scope of this article.

The Gastrula theory.—In invertebrates with holoblastic ova the blastula passes into a stage known as the *Gastrula.* Gastrula is,

properly speaking, a new name for a larval form called *Planula* by older writers; but the term is now generally employed to designate an ideal embryonic stage supposed to be common to all multicellular animals.

The blastula changes into a gastrula by a process of invagination. The entodermal area of the blastula flattens out, the ectoderm meanwhile expanding by multiplication of its cells; after flattening, the entoderm turns inward, forming at first a shallow cup, then a pit which has an opening or mouth, the rim of which is the ectental line. The larva is now a double sack, and has an external wall or ectoderm, and an internal wall or entoderm; the entodermic cavity is entirely distinct from the segmentation cavity. The process of gastrulation is here described as it occurs among the lower invertebrates.

Typical gastrulæ are the free swimming larvæ of many marine invertebrates. We may take as an example that of a sea-urchin, (Fig. 19). The larva is round; at one pole it has an opening, *M*, the gastrula mouth leading into an internal cavity; as this is a free swimming larva it is provided with long cilia for organs of locomotion; the cilia in many gastrulas are distributed over limited areas or they may be wanting altogether. The larva consists of a double sack,—a larger outer one of small epithelial cells, *ec*, the ectoderm; and a much smaller inner sack composed of larger entodermal epithelial cells, *en*; at the mouth, *M*, of the inner sack the two layers are continuous with one another; in the space between the two sacks, which corresponds to the segmentation

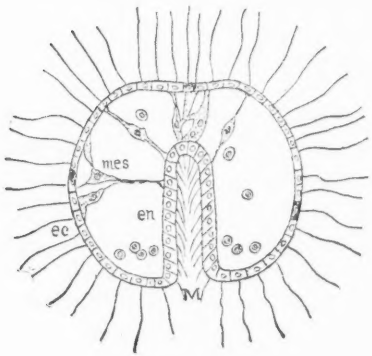

FIG. 19.

Section of a gastrula of *Toxopneustus lividus*, after Selenka; *ec*, ectoderm; *en*, entoderm; *mes*, mesoderm; *M*, mouth.

cavity, are a few scattered cells, the first members of the mesoderm, *mes.*

The entodermal sack of the gastrula is known as the *archenteron;* other terms are also in use, *e.g.*, mid-gut, cœlenteron, Urdarm, etc. The opening is known as the *gastrula mouth* (archistome, Urmund, etc.). The cœlenterates preserve the gastrula organization throughout life, but in all higher classes the archenteron gives rise, not only to the permanent digestive tract, but also to many appendages and derivatives thereof; and moreover the gastrula mouth closes over, and in vertebrates the true mouth is an entirely new formation which arises without any connection whatsoever, so far as known, with the gastrula mouth. By gastrulation the ectental line becomes the rim of the gastrula mouth.

A line passing through the centre of the mouth and the opposite pole of the gastrula is the so-called axis. Now if the mouth be elongated, there would at once be a new *longitudinal axis* marked out, and the gastrula would become *bilaterally symmetrical.* If, further, the mouth is pulled out into a slit, and in the process of evolution the lips come together and unite in their middle part, the animal would still have the two ends of the original mouth left open, and would so acquire two apertures to its archenteron, one anterior to serve as mouth, and one posterior to serve as anus. This hypothesis of the conversion of a gastrula into a bi-laterally symmetrical animal by the elongation of the mouth and concrescence of the lips or ectental line, was first suggested, so far as I am aware, by Rabl, *36.* A very perfect exemplification of the process is afforded by the developing ova of *Peripatus capensis* as shown by Balfour, *3*, and Sedgwick, *43*, Pl. XXXII. Figs. 23–26. There are, however, serious difficulties in applying the theory to bilateral invertebrates. I am strongly inclined to think that further research will obviate these difficulties.

In certain vertebrates and annelids the concrescence of the ectental line has been clearly demonstrated, but the process is rendered by secondary modifications much more complex than that described in the preceding paragraph.

The Gastrula theory is that all metazoa have a common inherited stage of development, which follows immediately after the diaderm; this stage is characterized by there being an outer ectodermal sack with a perforation, to the edge of which is attached the entoderm, which forms a closed inner sack, the archenteron.

The term gastrula was introduced by Haeckel, and is now universally used by embryologists. The discovery of the importance of the gastrula is due to the brilliant researches of Kowalewski on various invertebrates, including Amphioxus, then supposed to be a vertebrate. Haeckel then seized upon the idea of the gastrula, and wrote an essay, *21*, upon it, which from its brilliant style attracted much notice, and did much to direct attention to the important discovery of Kowalewski. Although Haeckel indulged his fantasy unduly, and was misled into speculations which are now unheeded and almost forgotten, he did great good by starting the interest of zoölogists in the right direction. By a remarkable coincidence Lankester published an essay, *31*, of a purport very similar to Haeckel's, at about the same time. A great deal remains to be done before the gastrula theory of evolution can be fully established, for there are many facts not brought into accord with the theory in its present form.

The gastrula, like the diaderm, varies greatly, the chief modifications depending on the amount of yolk present; this is illustrated by the accompanying diagrams, (Fig. 20). The mesoderm is intentionally omitted; A corresponds to such a larva as Fig. 19; the difference in size between the two sets of cells is slight but evident. In B the difference is more marked, and fairly represents a gastrula of Amphioxus. In C the difference is very great, and corresponds to that observed in certain gastropod larvæ. In

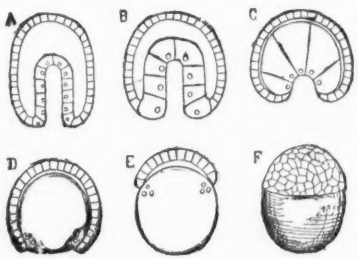

FIG. 20.

Diagrams of the principal modifications of the gastrula (see text), *A E* represent sections.

D the inner set is no longer separated into distinct cells, although there are a number of nuclei, each of which marks the centre of a future cell; in such instances we must regard the whole inner portion as not yet transformed into a definite entodermic *cell-layer*. This figure is particularly instructive, because it shows that what we call the yolk is not something distinct from the germ, but really belongs to the inner layer of the embryo. E shows a similar egg, in which the outer set of cells has not yet grown around the yolk. F shows the same egg, not in section but seen from the outer surface.

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NOTES ON THE LIFE-HISTORY OF *CHOROPHILUS TRISERIATUS.*

BY O. P. HAY.

ON the 22d day of last March, while searching the ponds about Irvington, Indiana, for Amblystomas and their eggs, I discovered some amphibian spawn whose parentage I did not then recognize; but which, after hatching, development, and metamorphosis, proved to be that of the little frog, *Chorophilus triseriatus.*

The eggs were deposited in an admirable situation for making observations upon them. A large tree, standing at the edge of a shallow temporary pond, had been overthrown; and when the roots had been buried, a hole some two feet deep had been left, and this was full of water. It was so cut off from the pond that by arranging a few sticks and leaves it was made very difficult both for the tadpoles coming from these eggs to leave the pool and for those of the other species to enter it. There were large numbers of the eggs, hundreds of them; but whether or not all had been deposited by a single female, I could not tell. The species is here apparently rare, but a single specimen having been captured. Many such animals, however, have a faculty for concealing themselves for years; until some lucky accident, or an unusually close search, reveals to us their real abundance.

The eggs were deposited in bunches of various sizes and were attached to branches and twigs which had fallen into the water. They clung to one another and to the twigs by means of the clear jelly that surrounded each egg. They had already gone well forward in their development, since each contained a larva of the form shown in Figure 1. It will be seen that the dorsa flexure is very pronounced, and the tail is thrown over the back. The diameter of each egg is about 3 mm.

Figure 2 represents the larva as it appears on the 28th day of March. It is now 5 mm. long, and has lost its dorsal flexure, but is coiled laterally within the egg membranes. Sections show the

nasal pits formed, the eye-balls beneath the skin, and the auditory organs as simple hollow cavities. There is no mouth, only a depression where the mouth will be. The "suckers," or "holders," are fully developed.

By the 5th of April the tadpoles had escaped and were swimming about in the pool. The mouth is not yet perforated, there are no gill slits, and the gills themselves appear as mere buds. It does not appear that they ever become important organs. The holders are present, but they seem scarcely as prominent as they were in the unhatched young. The larvæ are thin from side to side, and slenderer than are those of *Rana virescens* at the same stage. They are of a yellowish gray color, with punctulations of black. It is with great difficulty that, in sections, one can make out the cartilaginous lower jaw, the hyoid, and one or two branchial arches.

On the 11th of April the young have reached a length of 7.5 mm. The body is becoming broader and more pear-shaped, owing to the growth of the intestine. The eyes are completed; the iris is of a golden color. The back is now flecked with golden dots. They spend much of their time sticking to the sides of the aquarium, but it is probably not by means of their holders, since sections taken two days later show that these have disappeared. No external gills are visible; neither could I observe that water was being taken in. Sometimes when disturbed they would start off and spin round and round in the water for awhile before taking any definite course. By the rapid streaming of water over the body it was evident that a vigorous ciliary action was going on.

On the 13th the external gills were gone, water was to be seen streaming through the nostrils and out through the pore on the left side, which alone appeared to be open. The body is pear-shaped. The back is black, speckled with gold; the belly is also black and gold except along the middle line, where it is transparent enough to show the coils of intestines. The now open mouth is triangular, and the jaws furnished with black, minutely denticulated, horny sheaths. One specimen examined had these alone; another had, in addition, two rows of black horny teeth on the

lower lip. The convoluted intestines are loaded with fine sand and vegetable débris. The cartilaginous structures of the head have undergone astonishing development since the 5th.

By April 20 the length has become 10 mm. There is a bud of tissue on each side at the base of the tail, the rudiment of the future hinder limbs. The mouth is nearly surrounded by a row of fleshy papillæ, inside of which are the rows of horny labial teeth. There are now two rows on each lip, the one next the upper beak being interrupted in the middle line. All these teeth are finely notched at their tops, the whole forming a most admirable apparatus for scraping off the layer of algæ that covers everything in the water. Ciliary action is still going on over the body.

A week later the length has increased a little. By means of their sucker-like mouths they adhere to the vessel in which they are kept. They are probably at the same time busy feeding. The lower lip is now provided with three rows of denticles, a third short row having made its appearance outside of the others. The eyes are more lateral than are the *Rana virescens* larvæ.

Measurement of the tadpoles on the 4th of May shows their length to be 19 mm. The hinder limbs show signs of segmentation. The body is jet black, with dots of gold; the belly is nearly covered with gilt of a brassy reflection. In one specimen currents of water were seen to enter the nostrils, and feebler currents the mouth. One was seen to come to the surface for air, and others to emit bubbles of air beneath the water. Observation of these larvæ and those of *Acris gryllus* shows that the water used in breathing is drawn in through the nostrils and emitted through the pore on the left side until about the time when the forelegs are to appear. It is then drawn in, principally, at least, by the mouth. I have also observed in the case of both species that after the forelegs have been set free and the tail begins to be observed at least a portion of the water taken in by the mouth is sent out by the nostrils. This may be due to the partial closing up of the excurrent branchial pore. The stream may bathe the yet present gills; but if the water continues thus to be drawn in and expelled after the gills are absorbed, as I have

reason to think it does, we shall have then a sort of pharyngeal respiration such as Profs. Gage have observed in *Aspidonectes* and *Cryptobranchus*, and myself in three species of *Amblystoma*. This mode of respiration in the frogs named, if it really is such, differs from that in *Amblystoma* in that in the latter the water enters by the nasal passages and leaves by the mouth.

It may be proper here to describe the labial dentary apparatus of *Chorophilus* as compared with that of *Acris*, as we find it in maturer tadpoles of both. In *Acris* there seem to be but four rows of denticles, two on the upper and two on the lower lip; while, as already said, in *Chorophilus* there is a short third row on the lower lip. In the former species the teeth are not notched at their tips; in the latter each tooth is notched at the tip so as to present about eight little points. The teeth are also more numerous in *Chorophilus* than in *Acris*. This may be most briefly presented as follows:

Number of Teeth.	Chorophilus.	Acris
In outer, or upper, row of upper lip .	90	50
" inner or lower " " " .	80	44
" " or upper " lower " .	85	57
" second " " " .	95	60
" third " " " .	55	—

By the 26th of May the tadpoles had attained a length, in some cases, of 27 mm., 16 of which is tail. Many of them about this time succeeded in releasing their fore limbs from the skin which bound them down. There was so much difference in size among them that I was quite convinced that tadpoles of other species had invaded the pool; but this proved not to be the case. The difference was principally in size and plumpness; but it was evident that as soon as the fore-legs were released, and even before, there was a reduction in the animal's bulk.

These four-legged tadpoles were very lively and very timid, and darted about in great alarm when disturbed. They would also crawl out of the water on stones in the aquarium, and sit there in great contentment. They were also perfectly ready to leap out upon the table or the floor. It was easy to see even at

this period that they belonged to some species of tree-frog, since the hinder digits were furnished with disks; as were also the fingers even before they were set free. No stripes were yet visible. As the tail shows signs of absorption the body continues to shrink in size, probably owing to the shortening of the alimentary canal. The dorsal stripes also begin to appear, so that it becomes easy to recognize the species.

They now show a decided inclination to leave the water. They climb up the sides of the aquarium; and to keep them in netting must be put over it. Having no web on their feet they are poor swimmers, and many of them were found drowned. When free they doubtless early leave the water, and hide away among the sticks and leaves, where they are protected, and can find suitable food.

By the first of June many of the larvæ had lost nearly the whole of the tail. Others were slower in development, and it was not until the 12th of June that all had completely transformed. Twenty-five or thirty of these were shut up in a box containing dirt and chips, and covered with netting. An attempt was made to furnish them with insect food, with the intention of watching them further. They hid away under the chips, and lived for some days; but they grew emaciated, and many died, and the effort to raise them was abandoned.

I doubt much that this species is, to any considerable extent, a tree-inhabiting frog, Such specimens as have been taken where I could learn of the circumstances have been captured in the grass. Dr. Coues states, in the "Bulletin of the U. S. Geological Survey," IV., p. 290, that it was found in the greatest abundance in prairie pools and streams in Northern Dakota and Montana. Some of them were taken at Frenchman's river on the 1st of July. It is probable that even at that late season they were depositing their spawn.

EXPLANATION OF PLATE XXXV.

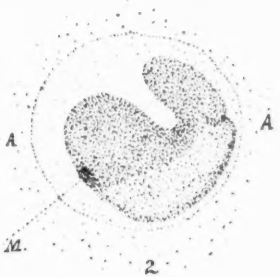
FIG. 1. Adult frog of natural size.

FIG. 2. Egg on March 22, with contained larva. A, gelatinous envelope around egg; M, mouth.

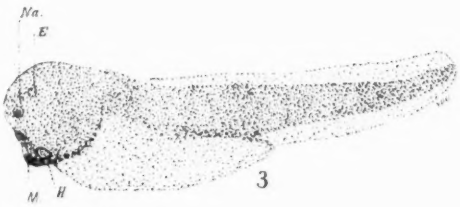
FIG. 3. Larva on 28th of March, straightened; Na, external nares; E, eye; M, mouth; H, holders.

PLATE XXXVI.

1



2



3

Chorophilus triseriatus.

PROF. D. W. C. DUNCAN'S ANALYSIS OF THE CHEROKEE LANGUAGE.

BY C. L. WEBSTER.

TO classify and define the words of an Indian tongue, to ascertain and codify its mysterious laws of expression, and, by means of literary associations, so wed it to our own as to give it a guarantee of prospective existence commensurate with that of the English, has hitherto been regarded as one of the most difficult problems in the science of language.

Prof. D. W. C. Duncan, of Charles City, Iowa, is one of the few men that have ever had the courage to undertake such a work, and the still fewer that have enjoyed a fitness for its execution. The language which he now has in the crucible of reduction is the Cherokee. By the accidents of birth, the tongue he is dealing with is, in one sense, to him a familiar vernacular. Besides this natural advantage, he enjoys that of a finished classical education, together with an instinctive taste for linguistic research, especially in the more remote and hitherto untrodden fields of that kind of learning.

He says, "Human language is not always and necessarily *expressive;* it is sometimes in the main only *suggestive.* Where there is an affluence of thought, there is a corresponding wealth in the means of expression. In that case, language naturally becomes much more elaborate and complicated in its structure. But in the lower grades of social life, where the sphere of ideas is small, there exists but little motive for linguistic improvement. The words are generally few in number, and limited in meaning. Many of them indeed can hardly be called *words;* they are more like unintelligible exclamations, whose office it is, not to imprint an idea, or a thought, upon the apprehension of the person addressed, as do the words of a cultured tongue; but rather to arrest the attention and direct it to the subject in hand, leaving the desired impressions to arise in his mind as the result of his own observation and reflection. In these rudimentary tongues

sentences are to be found very often in but an embryonic state. They are concise and extremely simple in structure. The great periods which seem so formidable to the stranger, will be found, when analyzed, to consist mainly of simple sentences of co-ordinate rank linked together, by implied or expressed connectives."

Besides the above general features, we are told by Prof. Duncan that the Cherokee is also characterized by a peculiar disregard for the distinct individuality of its words. In practice, they are often brought together and so consolidated as to give a whole sentence the brevity and consistency of a single word. Nor does the process of agglomeration always stop exactly at the point of mutual contact; the words often meet and mingle, like two drops of fluid, so thoroughly disguising the identity of each as to baffle the discernment of all except an expert in the use of the tongue. He illustrates as follows:

"Take the word-sentence *nēwē* (thou sayest). Released from the bonds of synthesis, it stands thus: *nē hē wē*; *ne*, an obsolete prefix; *hē*, thou; *wē*, say. Had any other consonant stood in the place of *h*, a fusion of the first two syllables could not have occurred. That letter being only an attenuated aspirate, the two adjacent vowels are regarded as standing in actual contact, a predicament for vowels which is strictly forbidden by the laws of the language. Hence the form of condensation: *n* (*ē h*) *ē wē* = *nēwē*.

Again, word-sentence: *tawālógä*; (do thou write them). Expanded, *tē hē awālógä*,—*tē*, a prefix denoting the plurality of the object of the verb, and may be translated by the pronoun *them*. Here *h* being regarded as incompetent as a separatrix, three vowels come in contact. To relieve this misadventure, to maintain the euphony of the sentence, and to conform to the law forbidding a hiatus, contraction is effected thus: *t* (*ē hē*) *awālógä* =*tawālógä*. It is noticeable that the pronoun in this case entirely disappears; and the fact that *hē* (thou) is the subject of the verb, is only made known by its absence.

An exceptional method of contraction is illustrated by the word-sentence, *hnätógä*, (do thou); expanded, *hē nätógä*; *h*(*ē*)*nätógä*.

There are six vowels in the Cherokee language, *ă ā ĕ ą ǫ ó*; and twelve consonants, d g h k l m n q s t w y. Every syllable ends with a vowel; and this rule covers all cases where the syllable consists of a single vowel.

The general law of contraction may be stated thus:

When a vowel comes in contact with another vowel, the one preceding is dropped; and the consonant of the preceding syllable unites with the following vowel, forming a new syllable.

It is obvious from what has been said, that the pronoun *hē* (thou) may take as many different forms as there are vowels. *Hē* is the original form; the others are derived as follows:

1. Hēnänogąwēskä; expanded, Hē nänogąwēskä.
2. Hē ālähógä; contracted, Hālähogä.
3. Hē ădąhögä; contracted, Hădąhógä.
4. Hē ąstó; contracted, Hąstó.
5. Hē ogątä; contracted, Hogątä.
6. Hē ótąnóhä; contracted, Hótąnóhä.

That is to say, the pronoun *hē* may be heard in conversation under six different forms: hē, hä, hā, hą, ho, hó, in addition to the many other guises which it may assume upon contraction with certain other words and prefixes that *precede* it, as we have above shown."

Prof. Duncan adds in this connection: "Now when we reflect that all the pronouns, more than fifty in number, with adverbs, modal auxiliaries, tense-endings, and a large family of numeral and personal prefixes (some of them obsolete), are never, or seldom, seen or heard of, except in these condensed forms of expression; and that each of these words is liable to assume any one of six different forms, according as it may happen to be touched, fore or aft, by the initial or terminal vowel of a neighboring syllable, in every case giving the whole word-sentence a new, strange and unexpected aspect, it is easy to appreciate the importance of a thorough mastery of the rules by which these myriad changes are effected; indeed, without such mastery, any progress in a scientific knowledge of the Cherokee tongue would be utterly impracticable."

Among the curiosities of Cherokee etymology, those pertaining to the pronoun are specially curious and interesting. Prof. Duncan says:

"The properties of the pronoun are chiefly person and number; though case is not altogether ignored. In English, the pronoun *we* may have a variety of applications; it may include the first and third persons, excluding the second; or the first, second and third; or the first and second, excluding the third; or the first and third, excluding the second. The Cherokee pronoun has a different form for each of these ideas; in some cases, *two* forms for the same idea. The *last two* ideas, in Cherokee, are dual in number. Thus:

1. { Ạtsē-, (1+3—2); derived forms, ạtsă-, ạtsā-, atsạ-, atsọ-, atsó-,
   { Ạkē-, (1+3—2); " " ạkă-, ạkā-, ạkạ-, ạkọ-, ạkó-,
2. { Ētē-, (1+2+3); " " ētă-, ētā-, ētạ-, ētọ-, ētó-,
   { Ēkē-, (1+2+3); " " ēkă-, ēkā-, ēkạ-, ēkọ-, ēkó-,
3. Ānē-, (1+2—3); " " ānă-, ānā-, ānạ-, ānọ-, ānó-,
4. Ạstē-, (1+3—2); " " ạstă-, ạstā-, ạstạ-, ạstọ-, ạstó-,

2d Per. Sing.

Hē (thou), derived forms, hă-, hā-, hạ-, họ-, hó-.

2d Per. Plu.

Ētsē-, (you), derived forms, ētsă-, ētā-, ētsạ-, ētsọ-, ētsó.

2d Per. Du.

Ēstē-, (you, 2), derived forms, ēstă-, ēstā-, ēstạ-, ēstọ-, ēstó-.

Ạ-, or Ọ-, (he), 3d Per. Sing.

{ Ānē- (they), 3d Per. Plu., derived forms, ānă., ānạ-, ānọ-, ānó-.
{ Ọnē- " " " " ọnă-, ọnā-, ọnạ-, ọnọ-, ọnó-.

Each of these pronouns may be converted into the reflexive form by suffixing the syllable dă, thus, Ọdă-, (himself); Hădă-, (thyself); Ạkēdă, (ourselves).

Besides these *simple* pronouns, there are a few compounds which bespeak two different persons at the same time, said persons being in different cases. The English sentence, "You help me," would stand in Cherokee thus: *Skēstāló.* Here the pronoun *skē-*, carries the meaning of both English words, (*you-me.*) Skē-, original; derived forms, squă-, squā-, squạ-, squọ-, squó-.

In the same way, gó-, (I-thee); gókē-, (they-me); ākē-, (he-me); tsó-, (I-you); ētsó-, (we-you); gówānē-, (they-them); and some others.

In view of such an array of pronominal forms, and knowing there is more to come, the learner is apt to faint with discouragement; but when he takes into the account the fewness of the *original* forms, together with the unvarying rhythm that marks the formation of the derived forms, it will be sensibly felt that it is no more of a task to master the Cherokee pronoun, than the same part of speech in Latin, or even English."

In reference to Cherokee lexicography, Prof. Duncan further remarks:

"In order that a word may be defined, it is necessary that it should be identified; yet it is a singular fact that no Cherokee can recognize the words of his own language (with small exception), even when seen in print or heard in conversation; though he may actually wield them with the tongue of an orator, or the pen of a poet. The cause of this is the fact that the Indian mind is trained to deal, not with single ideas, but with thoughts, or at least with groups of ideas. The Cherokee is not aware that his language can afford any word for *hand;* it is always *Ạquạyānē* (my hand); that is, the idea of *hand* is always attended, in expression, with a conception of the one to whom it belongs. Now if we should resolve this word, and assign to each idea its respective part, it would stand thus: *Ạquä ạyānē* (my hand). Yet if these words should pass under the eye of a Cherokee who was not skilled in the science of his language, he would doubtless fail to recognize them, and be apt to repudiate them as something foreign to his native vocabulary.

While what we have here said is largely true in reference to the nouns, it is much more so as to the verb. The Cherokee never expresses the idea of an action, except in connection with that of the actor, and often of the person acted upon. And the adjective, in expressing a quality, seldom loses sight of the object to which it belongs.

Hence the first and most arduous part of the Cherokee lexicographer's work is to identify the words to be defined. Let it be

our desire, for instance, to register and define the Cherokee word meaning the same as the English word *write*. It is to be doubted if it was ever heard or written except in some such conglomeration of vocables as *Wētsóyawälänätēyē*. Now to find the word of which we are in quest, this word-sentence will have to be resolved into its component elements thus:

We[1]-tsó[2]-y[3]-awäl[4]-ä[5]-nä[6]-tēyē[7]. We may then define as follows:

1. Wē-. *adv.* Thither; indicating motion.
2. Lsó-. *pro.* I—you; carrying the meaning of two pronouns.
3. Y-. A letter inserted for the sake of euphony.
4. Awäl-. v. t. *Write, draw, inscribe.*
5. Ä-. Tense sign, indicating the present tense.
6. Nä-. Mode sign, showing that the action affects *rational* beings.
7. Tēyē-. Sign of the infinitive mode.

It were easy to extend these illustrations of the work before us, without impairment of interest, or much danger of exhausting the source from which they are derived; but we are admonished by the limits of this article that the foregoing must suffice.

As touching the questions of ethnological science, there is no field of research more instructive than that of human language. The mind is the measure of the man; and so it is the essential personality of a race or a nation. The remains of art which a departed people leave behind them may suffice to give us a pretty clear idea of what they could do; but if we would know them as they were, we must needs study them through the medium of their tongue.

The few fragmentary Indian tribes that still remain are the custodians of a very rich store of linguistic material, the value of which, as data for scientific contemplation, cannot be easily overestimated. Not one of these tongues, however, can be expected to survive for a great while, except by the interposition of some friendly hand to save it from extinction. A fact like this can not be regarded by the scientist but with feelings of the deepest concern; for if it is desirable (and there can be few things that are more so) that an intelligible specimen of the red man's language

shall be preserved in the interest of science, the present is about the last opportunity that will ever be offered for the discharge of such a service. The time for a work of this kind, owing to the rapid decay of these Indian tongues, is necessarily short, and it should be diligently improved.

In order that a language may be of the greatest possible use as matter of reference in the establishing of scientific truth, it is not enough to be conversant with only a few of its more prominent features; it should be understood as a whole with entire familiarity. To this end it should be rendered as easy of access as possible by means of suitable guide-books of study. In a word it should, like a classic tongue, be reduced to a state of implicit subserviency to the will of any one who might have occasion to master its use or appeal to its facts.

A very serious want of this kind has long been felt, especially with reference to the aboriginal languages of this continent. The work which Prof. Duncan now has on hand is unique and thoroughly original, as well as rigidly scientific. When finished, it will, without doubt, constitute one of the most exact and exhaustive treatises on Indian philology that has ever been published. It will have the effect to rescue at least one of our many Indian tongues, the Cherokee, from oblivion; and by investing it with an intelligible immortality, make it an interesting fact for reference among students of philology for all time to come.

Charles City, Iowa.

SCULPTURED ROCK AT TREMPELEAU, WISCONSIN.

BY T. H. LEWIS.

LAST November, whilst surveying mounds in the upper Mississippi valley, my attention was called to some rock sculptures located about 2½ miles north-west from Trempeleau, Wisconsin. There is at the point in question an exposed ledge of the Potsdam Sandstone extending nearly one-eight of a mile along the east side of the lower mouth of the Trempeleau river, now known as the bay. Near its north end there is a projection extending out about seven feet from the top of the ledge, and overhanging the base about ten feet. The base of the ledge is forty feet back from the shore, and the top of the cliff at this point is thirty feet above the water. On the face of the projection, and near the top, are the sculpture figures referred to.

No drawings or descriptions of these fine specimens of ancient work having ever been published, I thought it best to copy them for the inspection of archæologists in a printed form. Whatever distinct markings were originally cut upon the face of this rock are doubtless there now, and the group as traced is complete and entire, and in its primitive condition, for it has not been mutilated by man nor perceptibly injured by exposure to the elements. Great care was taken to obtain correct tracings, the size of nature, and these having been reduced by pantograph the copy remains an accurate facsimile of the original.

The centre part of the rock projection on which these figures appear, faces to the west, the sides falling back at a somewhat obtuse angle to the parent ledge. Owing to the horizontal extent of the space covered by the carvings they cannot well be shown in one connected drawing, so they are divided here for convenience into three groups of nearly equal size. The following detailed description accounts for all the separate forms, and they are numbered in their natural order from left (north) to right.

NORTH FACE.

Fig. 1 is an outspread hand 13½ inches long.

WEST (FRONT) FACE.

Fig. 2 is an outspread hand 16½ inches long. The thumb is cut through the angle of the rock and ends on the north face. The middle finger also extends to the top surface of the rock.

Fig. 3 is an outspread hand 17¼ inches long. The two hands (2 and 3) are apparently right and left hands, the little finger of one overlapping that of the other.

Fig. 4 is an outspread hand nearly 13½ inches long.

Figs. 5, 5, are five so-called canoes. They are somewhat crescent shaped, but all vary more or less in outline.

Fig. 6 has the same form as the preceding, but the additional upright portion overlaps it.

Figs. 7 and 8 are also of the same form as 5, but 7 is cut in the bottom of 8.

Fig. 9 probably represents a fort, and its length is 18½ inches.

Fig. 10 is a nondescript, and it partly overlaps 8.

Fig. 11 is a nondescript four-legged animal. Its length in a straight line from the end of the nose to the tip of the tail is 10½ inches.

Fig. 12 may be intended to represent a foot, but possibly it may be a hand. It is 7¼ inches in length.

SOUTH FACE.

Fig. 13 is an outspread hand a little over 13 inches long.

Fig. 14 undoubtedly represents a foot, and it is 4½ inches long.

Figs. 15, 15, are of the same class as Figs. 5.

Fig. 16 has the appearance of representing a bone, although somewhat distorted.

Fig. 17 is an outspread hand nearly 14 inches long.

Fig. 18 is an outspread hand about 6¾ inches long.

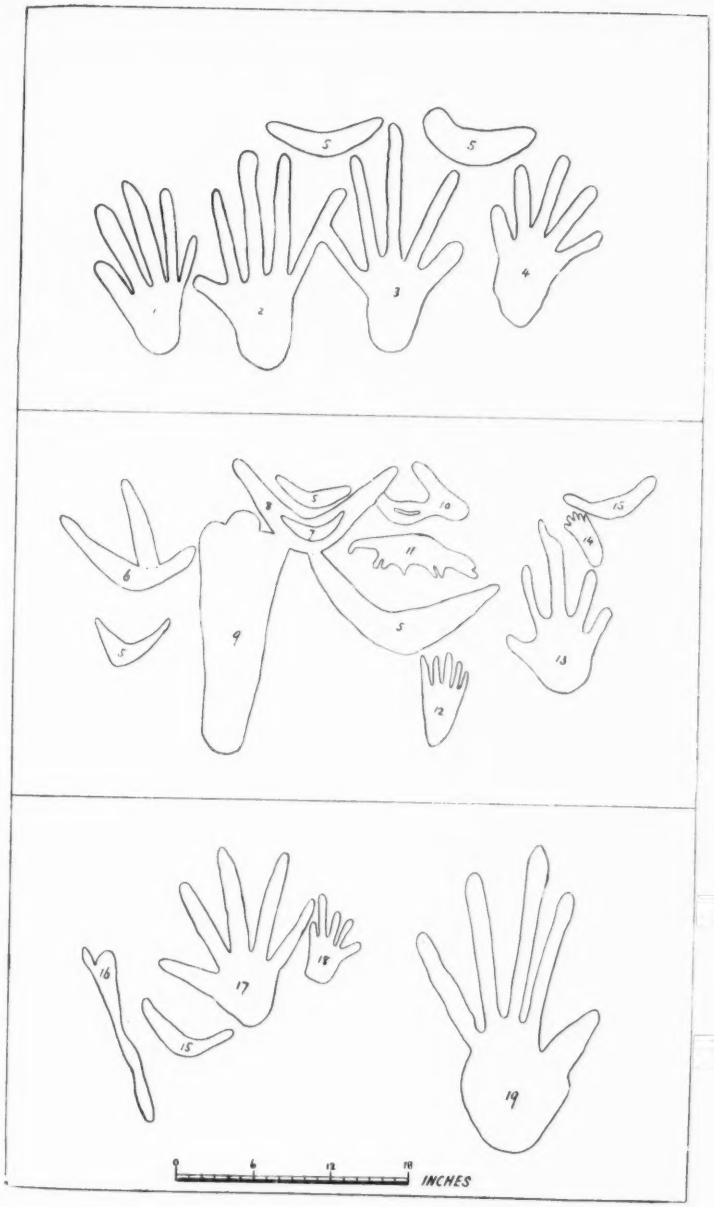
Fig. 19 is the largest hand, and deserves a more particular description. The palm is 10 inches long and 8¼ inches wide. The length of the thumb is 5¼ inches, of the index finger 10¾

inches, of the middle finger 13½ inches, of the ring finger 11½ inches, and of the little finger 9¼ inches.

These figures are sunk in throughout—intaglios—instead of being mere outlines, and vary in depth from a quarter of an inch to fully one inch. Although the surface of the rock is rough the grooves were rubbed perfectly smooth after they were pecked or chiseled out.

Such is a concise account of one of the most interesting antiquities of the country lying between the Trempeleau and Black rivers, and I shall feel gratified if by my instrumentality it shall be rescued from oblivion.

PLATE XXXVII.



SCULPTURED ROCK AT TREMPELEAU, WISCONSIN.

ORIGIN OF THE LOESS.

BY JNO. T. CAMPBELL.

THE loess, as understood in Indiana, is a thin sheet of very fine clay, or a sand so fine that it appears like clay, which covers the glacial drift. That the boulder clay, or till, here, is the work of an extinct glacier, is more evident the more it is studied. I have no more doubt of the past existence of a glacier here, than if I had been present when it existed, and seen it myself. But how came the fine yellow or buff-colored, and in many places ash-colored, clay on top of the glacial clay. To every observer the first thought that will occur is that it is the sediment from a body of still water. Next query—How did the water originate?—for it must be fresh water. Well, the melting glacier furnished it. Very well. A little more observation, and we find the clay at elevations rather high for a glacial pond to cover. Then we construct imaginary ice dams to hold the water in sufficient depth and time to make the deposits we find. Following our investigations southward we find the loess almost to the Mexican Gulf, where not only ice melts, but alligator eggs hatch in the sand; yet we construct an imaginary ice dam below the most southern loess to account for it. Then the ice dam theory becomes absurd, and we cast about for another cause. The wind-sifted sand from the western desert next suggests the cause. But it too has difficulties to be reconciled and harmonized that seem insurmountable.

If the clay were due to glacial lake deposits, we should expect the lowest valleys to contain the thickest beds of clay. But in my locality (Rockville, Ind.) the reverse is true. The highest land, and ridges in particular, have the thickest yellow clay, free from coarse sand and gravel.

What cause or causes could produce this clay that will not be contradicted by well-known existing facts?

I suggest some causes now at work that I think could and *did* produce the clay in question.

Some writer whom I have read often, Prof. G. K. Gilbert I think, said (in substance) he always liked to have all the steps, processes and observations by and from which an investigator has arrived at his conclusions. I like this myself, and shall, at the risk of being tedious to the reader, give my observations, impressions, conclusions, changes of opinion, disappointments, etc. Up to and for several years after 1872 I accepted the teachings of the books on Dynamic Geology with childish confidence. I supposed the surface, gravel-less clay was the sedimentation of a still lake. That year (1872) I had occasion to cut down a sugar maple tree in what is now the fair ground at Rockville, Indiana. The tree was about twenty inches in diameter at the stump. When it fell, the stump was so nearly sound that I did not notice a very small decay in the heart. I cut off eight feet of butt, and split it into quarters. It split as easy and straight as pine. When I halved it, I found a long, cigar-shaped, rotten heart, six feet long, by about six inches diameter. The centre of this rotten place was as perfect yellow clay as I ever saw. The fine grit could be easily detected by the teeth. Following it from the centre to the sides and toward the ends, the clay gradually changed to wet, soft, rotten wood. There was no distinct line where the clay ended and the rotten wood began. This was a curiosity to me, and I kept the sample several years. There was no hole in the body of the tree where any insect could then carry the clay in, and I doubt if there ever had been a hole grown over and closed over by concentric growths of the tree. I showed this to many people and told it to many more, and among the number to my teacher, Prof. B. C. Hobbs (Ex-Supt. Pub. Inst. Ind.). Being a Quaker he replied thus: "Thou hast not carefully observed it. A crawfish working up from below happened to strike the hollow of the tree, and kept hunting upwards for the surface of the mound, and thus filled the cavity of the tree with clay." A few days later I took my axe and visited the stump. The decay at the heart on the top was so small I could not put my fingers in it; but I cut the stump off a foot lower, and there it was entirely solid and sound. How came that clay to be sealed up in that tree? was the query. I then kept a watch out for all rotten logs and stumps

that came in my way, and found that in very many of them there was a strong resemblance to the yellow clay, but I never again found as perfect a sample as the sugar tree mentioned. I often found grains of sand in the heart of rotten stumps and logs, where I could not see any possibility of its being carried in by insects. I have found gallons of rotten wood and sand mixed in the hollows of trees fifty feet or more above ground, where the rains in following down the bodies and limbs would trickle inside the hole, and be there retained till evaporated. This (finding of sand) is very often the case with white oak. Did the insects carry it there? Did the birds carry it there? Did the wind drift it there? If the latter, then the rough outside bark would hold much of it in the crevices. But not a grain could I find there.[1] Then there are the leaves of the trees, which by a careful investigation I found to be, when compressed, equal to the last growth of the mother tree, or in the life time of a tree the compressed leaf fall is equal to the wood volume of the tree above ground. The compressed annual leaf fall in our dense forest I found to be one thirtieth of an inch. The body of the trees will make the same volume as the compressed leaf fall of their life-time. (I don't claim this as mathematically exact, but it is approximate.) Thirty years will make one inch of compressed leaf fall. One thousand years will make thirty-three (or more) inches. The bodies of the trees making as much more, we have sixty-six inches of decomposed trees and leaves for one thousand years—not allowing that any part will be reconsumed by the succeeding trees. Then add the unknowable volume of dead buffalo, deer, bear, and other animals, together with the birds and insects, with the excrement of all three during their lifetime, and we have a great volume of recently created matter, some of which must remain on the surface in some form. What form more probable

[1]Very recently I have found dark sand in several hollow black-walnuts, where the hollow was at the ground and the sand was mixed with the rotten wood inside the trees and three to seven feet above the outside opening; so that it was impossible for the rains to have washed it into the tree, and very, very improbable that it was carried in by the wind. Beside, I must remark again, that if carried in by the wind the crevices in the rough bark should also contain a great amount, but it takes the closest search to find a single grain.

than the surface yellow clay? This too is consistent with the thicker clay on the higher lands where vegetation first existed.

But chemistry teaches that it is impossible that trees, roots, leaves, and the flesh and blood of animals, birds and insects should turn to clay or sand. Then the more wonderful the facts I submit herein. For the time being I shall treat the facts according to their appearances, for appearances point so strongly, that the investigator on the field, shovel in hand, requires a constant effort to doubt them. But I remember too that the appearance of the surface of the earth is flat.

But here is a large erratic glacial bowlder on top of very recent creation. Why was it not covered by this recent creation? Ah, I see; once on top by any accident at the end of the glacial epoch, the subsequent freezing and thawing would keep it there. The freeze takes place at the outer edges first, forms an air-tight box, and in expanding lifts the bowlder, thus forcing a vacuum under it, which is filled with water by suction, which water is next frozen, causing still another lift and expansion. This second lift raises the bowlder above the first outside frozen support, causing a crevice. The succeeding thaw, which takes place first at the outer edges, forms a thin slush which fills the crevices, acting thus as props or supporting or staying wedges. Sometimes a bowlder will be so covered with a drift of leaves or the fall of a tree that the freeze does not get enough under to lift it. Then it ceases to climb on top as the building goes on, and it will in time be found in the midst of the surface yellow clay as we have often seen them.

Then again we find stray glacial gravel interspersed among the gravelless clay. Query—How came it there? The crows may have carried it and dropped the pebbles, as they do to-day; or the squirrel and other similar habited animals in digging through the leaves after fallen nuts may have kept them scratched up to the surface for a long time, and then by chance they were overtaken by a leaf drift, and remained where we find them to-day, in the midst of the surface clay. Also, animals burrowing in the gravel would carry the gravel up from their holes and leave it on the surface.

Then the roots of the trees cut a great figure in this work. Think of the millions, yea, billions of roots and rootlets that have occupied the upper part of the gravel. I feel confident that there is not a cubic inch of ground in the forests as they exist here, that has not been occupied by a root or rootlet, from the surface to three feet down, in the last thousand years. What has become of them? In twenty years at most after cutting down a forest, no trace of the roots or rootlets can be found here. They do not leave their cast, or even a trace of brown mould.

About two years ago I was riding homeward over the gravel road south-east of here (Rockville, Indiana), noticing the exposures along the road gutters. In many exposures the line between the "upper yellow clay" (as it is called here) and the under glacial clay (mixed with gravel) was as distinct and marked as the crack in a floor. When near the hill top on the east side of Raccoon creek, the surface clay suddenly changed to yellow sand. Away went my theory in a minute, which I had been years building. There was a small locality where the surface was sand instead of clay. Trees had grown, shed their leaves, died and rotted there, and been succeeded by others as abundantly as where clay existed. Do trees turn to sand also? I queried. Scarcely probable. But what has become of the trees, their leaves and rootlets, that have been growing on and in this sand for thousands and thousands of years? A little brown surface mould about six inches thick is all I can see to represent them.

Last May, while locating a bridge site across said Raccoon creek, I noticed in the steep bank the ends of the roots and rootlets of stumps and dead trees, and in some of them all had decayed and been consumed except the bark, which was filled with a sandy loam the same as the surrounding earth. Been carried into the hollow bank by the floods, I thought. But I dug into the bank after them, and found them thus filled in the bank a distance of over three feet; and in following these into the bank I ran across still others filled in in like manner, and lying parallel to the lines of the bank, where the flood never had touched them. Some of the roots were simply rotten wood inside of the bark,

which was still fairly sound, for the bark is the last part to rot. Some root bark was filled with a mixture of sand and rotten wood. One was filled with rotten wood and a seam of sand shaped like a thick-backed knife blade lying lengthwise of the root, the back resting on the bottom, and the edge reaching to the top side of the hollow root bark. Since that time I have examined many roots along hillside exposures by the roadsides, and have found that the bark of the roots at a certain stage of decay will be filled with the same kind of earth in which the root lies. This would suggest that the sand or clay is carried into the hollow bark by insects. But I have found such root bark packed full of sand or clay where I thought it impossible for any insects large enough to handle such matter to get in, unless on leaving they sealed the hole so perfectly as to baffle observation. Last week I found one root bark about four feet long, the butt end filled with rotten wood and sandy clay about equally intermixed. The middle part was packed tight with sandy clay, and the top or smaller end was filled with damp rotten wood. In this case there was no noticeable insect pathway to the middle. I have dug trenches around old stumps and dead trees two to three feet deep to see what the old roots would show. Many showed at a distance of eight feet from the stump no traces of the roots whatsoever. In some I have found the common ants, and with them dark balls or lobes of mud about the shape of wheat grains, and a quarter to a third the size of the wheat. The teeth could plainly detect the grit in them.

Suppose the trees do not reform into clay and sand, and that the insects carry the sand and clay into the root bark and into the rotten logs and stumps. They can carry none but the finest material. The gravel would be left behind, and this alone would in time work the finer material to the top.

The crawfish is an industrious agent in wet lands in bringing up the lower earth to the surface. I have been examining their holes for the past six months, and in that time I have failed to find them bringing up any coarse material, though boring through the yellow into the glacial clay. I have so far found no gravel larger than bird shot in the cones which they build up about

the top of their holes. The crawfish is a queer citizen. I can't understand him. I fail to see where he puts all the dirt that must come out of his hole. Last year I poured about a bushel of dry sand into one of his holes where many others were dug near by without filling it; yet the mud balls he had stacked up about the hole would not have filled my hat crown.

The ants too are known to bring a considerable quantity of earth from beneath to the surface in building their hills. Only a few days ago I was surveying in a five-acre cow pasture at Rosedale, a village in the south part of this county, and there I noticed that wherever the excrement of the cow was dropped, a bug which lays its eggs in a ball of the excrement and buries it in the ground, had carried up great quantities of fine earth from the excavations below. At a very recent one there was fully a gallon of fine earth piled up on the ground. This was on the second or terrace bottom of Raccoon creek, and over a gravelly subsoil.

On the insect hypothesis, there would of course be a limit to the thickness of each surface formation. Insects will dig no deeper than will serve their necessities. I have no reason to suppose they would go deeper than three feet; but I have often seen the yellow clay ten to twelve feet thick on the high ridges. This would require a deep digging insect, or else an accumulation from some source above the surface. The crawfish would dig deep enough, but he leaves the field when it becomes high and dry. Besides this, if the fine material had been taken out of the top of the glacial, gravelly clay, it would have left a stratum of clean gravel as far down as the fine material had been thus extracted, which we do not find to be the case here.

I notice in the second or terrace bottoms along the Wabash river in this vicinity a coat of fine sandy loam on top of the original gravel and sand, which latter was left by the Wabash when it carried ten thousand times as much water as it now does. There has never been any slack water over these terrace bottoms since the Wabash which made them dropped into its present limits. I shall some time try to prove what I here merely assert, to-wit: That the ancient water supply of the Wabash was suddenly cut off, and there was one last great flood, which left its natural

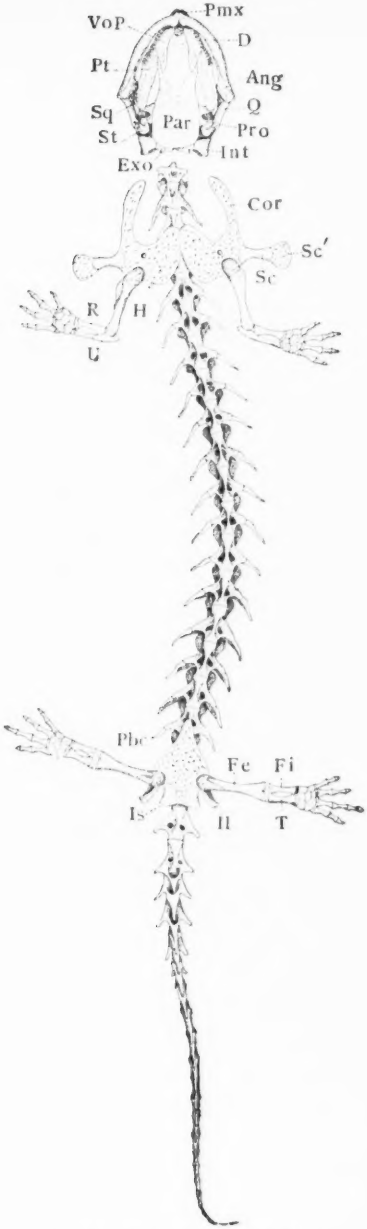
marks, and there has never been another large enough to efface or even modify these marks. Therefore the loess covering of these terrace bottoms must have some other than an aquatic origin.

In the flat table lands of the Wabash country, where the rainfalls have lain on the ground till removed by evaporation, the surface clay has an ashen color. On the high ridges, and at the crests of hills or ravines in the flat wet lands before mentioned, the surface clay is yellow, or buff colored. In the terrace river and creek bottoms the color is generally ashen, and the material a sandy loam, with occasional spots of pure yellow clay.

If this loess is decomposed vegetable and animal matter, why does it assume so many shades of color, and varied coarseness or fineness of shades of sand grain, being buff colored on the high land, ashen on the flat and the terrace bottoms, black in the Illinois prairies, and Indiana swamps? I do not pretend to answer, "Sufficient unto the day is the evil thereof." Nor do I know why the first fifteen outside growths of a white oak (and varying numbers for other trees) are white and will decay in a short time after the tree is killed, and all the inner growths are red and will endure the weather many years after the white growths are gone; but it is a *fact*. Fifteen years from to-day, all the present white growths will be red and far more durable, and new white growths will have formed outside of them.

My observations have been confined to my own locality, and my deductions may be very wrong. I submit them for whatever they may be worth.

PLATE XXXVIII.



Cryptobranchus Alleghaniensis.

RECENT LITERATURE.

Cope's Batrachia of North America.[1]—This is an octavo of 515 pages, with eighty-one plates executed by phototype process, issued by the U. S. National Museum as its Bulletin No. 34. It is one of a series of monographs on North American Vertebrata projected by Professor Baird at the time of the establishment of the Museum of the Smithsonian Institution, which has since become the U. S. National Museum. The monographs of the Mammalia and Birds were published by Professor Baird himself, as Volumes VIII. and IX. of the Reports of Surveys for a Railroad to the Pacific Ocean. The preparation of those on the Reptilia and Batrachia were delegated to Professor Cope, and he has been for some years accumulating the material and observations which are described and recorded in the present volume. Although not published in the same form and style as the monographs of the Mammalia and Birds, the present volume will be welcome to students of the interesting forms of which it treats, and none the less on account of its convenient size. The large material of the National Museum has been thoroughly sifted, the characters of the species defined, and their varieties pointed out. In the latter regard the work will be found to be especially useful to students of specific variation, as numerous sub-species are defined, and their distinction from mere varieties dwelt on. The total number of species described is 107, which are referred to 31 genera. The species are distributed in their orders as follows: Proteida, 2; Urodela, 53; Trachystomata, 2; Salientia, 50.

Among the new species described may be mentioned *Batrachoseps caudatus*, a salamander with an excessively long tail, from Alaska; a species of the tropical genus Hypopachus (*H. cuneus*) from Southwest Texas, and a new Bufo (*B. aduncus*) from Northern Texas.

The organography is extensively described and figured, but only the osteology is very completely represented. This portion of the work is thorough, and includes many new observations, especially on the carpus, tarsus and hyoid apparatus. A figure of the skeleton of the larva of the *Chondrotus tenebrosus* of the streams of California and Oregon is given, and its remarkable characters are pointed out in the text. The remarkable hyoid of the *Chioglossa lusitanica* is described for the first time. We copy here the figure of the inferior view of the skeleton of the hellbender (*Cryptobranchus alleghaniensis*), and a view of the viscera of the *Siren lacertina* (Plates XXXVIII and XXXIX).

[1] The Batrachia of North America, by E. D. Cope: Bulletin of the U. S. National Museum, No. 34; Washington; issued July 15th, 1889.

The illustrations are, with a few exceptions, well executed, but the paper on which they are printed is poor. To this may be excepted two lithographs which close the series. The subject is not, however, so fully illustrated as its scope demands, as there should be plates of the principal features of every genus. This we do not find, although some of the genera, as Amblystoma, Hyla, Bufo, and Rana, may be excepted from this criticism. An especially valuable feature of the work to American students is the illustration of the osteology of genera exotic to North America. This feature, together with the exhaustive character of the systematic analysis, renders the book a manual of the class at large.

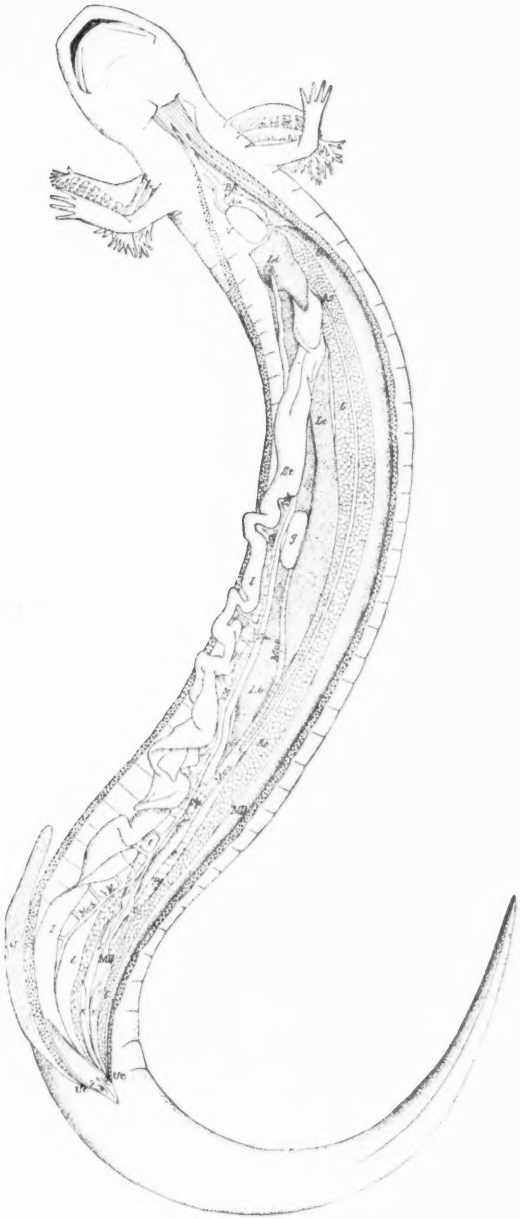
Frequent reference to the habits of the species is made. We make the following extracts descriptive of the ways of these often abundant denizens of our forests and swamps. Of the *Amblystoma tigrinum*, Prof. Cope remarks (p. 83):

"The larvæ of this species are exceedingly abundant in all still water in the Rocky Mountain region and the plains. They are rapacious, eating animal food, and taking the hook readily. Late in the summer they complete their metamorphoses and take to the land, where they hide in the holes of marmots, badgers, etc. From these they emerge during and after rains. The larvæ are much less frequently seen in the East, where the species is less abundant, and the opportunities of concealment are greater. Market Lake is a temporary body of water covering many square miles in Eastern Idaho. It is formed by the overflow of the Snake River in Spring. On its shores I have found this species. On the shore of an adjacent pond of more permanent character I have observed this species occupying vertical holes, which were kept filled with water by occasional waves, but from which their heads emerged into the air. In this position their branchiæ were gradually absorbed. An adult from New Jersey occupied a burrow in the soil of my fernery for several weeks. The burrow had two orifices, in one or the other of which its head could be generally seen, observing what was going on."

The larva of *Chondrotus tenebrosus* is thus described:

"The larva of this species frequently exceeds in dimensions that of any other species, and quite equals the adult. It is a uniform lead color, or sometimes blackish, and the muzzle is rather abruptly shortened. The tail has a fin at its extremity, which extends also well anteriorly on the superior edge. The digits are flattened, and their apices are protected in many specimens by a horny cap of a blackish color. This larva, however, differs from that of other species of the genus in other characters of more importance. First. There are no

PLATE XXXIX.



Siren lacertina.

teeth on the splenial bone. (I have not examined very small specimens.) Secondly. The branchiæ have a peculiar shape. There are no processes such as exist in all other Urodele larvæ, but the fimbriæ arise from the edges of the vertical laminæ which separate the pharyngeal fissures (Fig. 3, p. 3, No. 7). The superior part of the lamina is a little more produced than the inferior, so as to form in some specimens, on the third lamina, a short process. This type of external branchiæ does not resemble any of those of the perennibranchiate types, where there are always processes which are frequently furnished with more or less numerous rami. Thirdly. The teeth of the larva are stronger than in the adult. They are compressed, double-edged, and acute. Having thus a dagger-shape, they can inflict a severe bite.

"As they approach maturity, the marbled colors begin to appear. They can probably reproduce without undergoing a metamorphosis, since I have found eggs in the ovaries ready for deposit.

"I observed these larvæ in some tributaries of the McCloud River, near Baird, Cal. They swam with great rapidity, darting about and hiding themselves among the fallen leaves that covered the bottom. I took from the stomach of one of them a larva of its own species of one-third its size. They are common in the mountain streams of Northern California and Western Oregon. The skeleton of a large specimen from Salem, Oregon, is figured on Plates 20–21. The hyoid apparatus of a younger larva is represented on Pl. 22, Figs. 2–3."

Bufo lentiginosus americanus is thus noticed:

"Dwellers in the country are familiar with the voice of this species in the early Spring, which is the season of the deposit of eggs. These are laid inclosed in a long, thick-walled tube of transparent albumen, secreted by the walls of the oviducts. These tubes lie in long spiral strings on the bottoms of the ponds where they are deposited. The young hatch out early, and are of a darker color than those of others of our Salientia. They retain the dark color till near the time of the completion of the metamorphosis. This takes place at an earlier date than that of the Ranæ, and the completed young are scarcely as large as those of the Hylæ or of the Scaphiopus. The voice of this species may be heard well into the summer. It is a sonorous ur-r-r-r-r-r, which may be readily imitated by whistling while one utters a deep-toned vocal sound expressed in the above letters. Individuals differ in the pitch of their notes, but a chorus of them has a weird sound well befitting the generally remote spots where they congregate and the darkness of the hour. When not thus engaged, they often take up their abode beneath the doorstep of the farmer's house, and issue in

the evening to secure their insect food. They progress by hops, and only walk on very rare occasions."

Of *Rana virescens* (*halecina*) it is said:

"This species is especially an inhabitant of swamps. It is found in great numbers in those that border the large creeks and rivers of the Atlantic coast, and is comparatively rare inland, where it gives place to other species. With the *Acris gryllus*, it is the first species heard in Spring, and although its voice is not loud, the noise produced by thousands of them is deafening when heard close at hand, and is transmitted through the atmosphere for many miles. It may be imitated by the syllables 'chock, chock, chock.' As a harbinger of Spring it is always welcome."

The habits of the *Hyla pickeringii* are thus described:

"This, our most abundant Eastern species [of Hyla], is much more generally known by its voice than appearance. After the rattling of the *Acris gryllus* in the marshes and river banks in the lowlands is fairly under way, during the first bright days of Spring, the shrill cry or whistle of this little creature begins to enliven the colder swamps and meadows of the hill country. Different individuals answer each other with differently toned voices of a single note. This is exceedingly shrill and loud; the muscular force employed in expelling the air from the lungs seems to collapse the animal's sides till they nearly meet, while the gular sac is distended with each expulsion to half the size of the head and body together. They are chiefly noisy in the end of the afternoon, but in shady situations or on dark days may be heard through the morning and noon. When the breeding season is over they may be still found, but with difficulty, among fallen leaves in low places, where their color admirably adapts them for concealment, or in cellars, or on the ground in the woods. Not till the near approach of Autumn do we have evidence of their ascent into the trees. Then, when the wind is casting the first frosted leaves to the ground, a whistle, weaker than the Spring cry, is heard, repeated at intervals during the day, from one part of the forest to another, bearing considerable resemblance to the note of the purple finch (*Carpodacus purpureus*), uttered as it is while flying. These voices are heard during the same season; that of the Hyla is distinguishable as slightly coarser, or more like a squeak. Both are associated with the weak chirp of the late *Dendræca coronata*, as it gleans its insect food on its Southern flight. These are the latest sounds of Autumn, and soon disappear before the steady advance of the ice king."

A bibliography, from which we notice the omission of some titles, and a full index to both plates and text close the book.

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General Notes.

GEOGRAPHY AND TRAVEL.

America.—The Gran Chaco.—Capt. J. Page, of the Argentine Navy, has in the March issue of the Proc. Roy. Geog. Soc. described the Gran Chaco and its rivers, accompanying his description with a map. This tract of flat country, lying between the tropic and 29° S., extends eastward to the Parana and Paraguay, and westward to the province of Santiago del Estero. Its area is 180,000 sq. miles. About one-third belongs to Paraguay, and a small part to Bolivia, but the bulk is in the Argentine Republic. The Argentinian portion is divided into two governorships, the Chaco Central, between the Pilcomayo and the Bermejo, and the Chaco Austral. The latter has extensive primeval forests, and is watered by many small streams. Across the entire Chaco, between 61° and 62° W., extends a depression, causing the waters of that part to be discharged into streams that find their way into the large river by first flowing away from the sea. The Pilcomayo has dark or brownish water, and runs southeast, parallel to the Bermejo, at a distance of about 130 miles. It has never been ascended, and the section between 61° and 62° W. is quite unknown. Both the great rivers are obstructed by narrow argillaceous beds, quite removable, and by fallen trees of indestructible wood, which fall into the river beds through the eating away of the banks beneath them. Neither stream receives tributaries throughout the lower and longer part of its course, but the impermeability of the subsoil prevents undue absorption of the waters. At a spot close to 22° S. the Pilcomayo's main stream, after running due south, turns north, and then again southward, yet some minor branches flow tolerably straight on. It is here that the river has been lost to explorers. Capt. Page states that the expedition commanded by M. Thonar in no way elucidated the geography of the river.

The upper waters of the Pilcomayo are in Bolivia, and it passes through the province of Caiza, the Bolivian Chaco, after leaving the mountains and before reaching the Argentine territory. The Bermejo, so called from the red tint of its waters, is formed by the aggregation of a number of small streams rising in the hilly interior of Bolivia and Argentina, and at Oran, lat. 23° S., where it receives the Zenta, be-

comes a large river; a few miles below the San Francisco joins it, and from this point to its mouth, 900 miles, it receives no tributary of any importance. All changes in the course of the Bermejo and of the middle and lower sections of the Pilcomayo exhibit a tendency to swerve to the eastward. The most important alteration of recent years was that of the Bermejo, which in 1869–70 became deflected at 23° 40′ S. and 63° 35′ W. from its ancient bed, and did not find a new one until 1872, when the main body of waters took a parallel course to the north and east of the old bed, forming an island 200 miles long. The Gran Chaco is no desert, but a rich alluvial lowland, fitted for colonization, which is hindered by the want of knowledge of the rivers and their shiftings. The forests yield many valuable woods, among them the tatané (*Portiera hygrometrica*), the palo rosa, the *Cesalpinia melanocarpa*) the urendey, rurupay, and quebracho, three species of algarroba or Prosopis, and the palo santo or lignum-vitæ. There are also many native fruits of good quality. The Austral Chaco has been developed along the banks of the Parana, where many prosperous colonies exist, and there is a successful colony about 140 miles from the mouth of the Bermejo. There are not more than 30,000 Indians in the entire Chaco. In the discussion which followed Captain Page's description of the Gran Chaco, Colonel Church said that the rainfall of the Chaco, or forest region, was from November to May, and was a downpour of some eighty inches. The rainy season of the Pampas was not at the same time. During the rains there was at the head-waters of the Bermejo a lagoon forty leagues across. The Pilcomayo, at 180 leagues from its mouth, filtered through a sandy swamp 100 miles across, and its bed above this was a mass of sandbanks, falls, rapids and snags. The Gran Chaco was in flood-time almost a lake region, and the upper Paraguay became an inland ocean. This flood district extended northward to the falls of the Madeira, 11° S., and northwest across the Beni almost to Peru. In the Beni there was a lake of 20,000 square miles, two to seven feet deep. It had been calculated that the Bermejo annually delivered into the Paraguay 6,500,000 cubic yards of detritus. Under these circumstances, navigation of these rivers seemed almost impossible.

The Selkirk Range Glaciers.—An interesting account of explorations in the glacier regions of the Selkirk range, west of the Rocky mountain water-divide, on the Canadian and Pacific railway, is given by the Rev. W. S. Green in the March issue of the Royal Geographical Society's proceedings. Mammalian life seems to be particularly abundant in this range, and the strange habit of the Sewellel for

gathering flowers and laying them bouquet-fashion, stems together, at the mouth of its burrow, is enlarged upon. The notes are accompanied by a map which shows the great Illecellewaet glacier, with its accompanying névé, the Lily glacier, and those of Sir Donald, Dawson, Deville and Geikie. Most of the glaciers are at heights of from 7500 to 8800 feet, while the mountains rise but to 10,645 (Sir Donald mountain) and 10,622 (Mount Bonney).

Colonel Labre's Travels.—Colonel Labre, in 1887, crossed overland from the india-rubber settlements on the Madre de Dios, to the nearest navigable point on the Aquiry tributary of the Purus, in order to ascertain whether there were facilities for the construction of a road, and eventually of a railroad, to supersede the present route down the Madeira, which is so arduous that it needs thirty-four days to pass 161 miles, between San Antonio and the mouth of the Beni. The distance from Novo York, on the Aquiry, to Amapo, on the Madre de Dios, was found to be ninety-three miles, with only two rivers to cross.

The Ibuxy tributary of the Purus had previously been explored by Colonel Labre. In the wet season this river is navigable from its mouth to the falls, 370 miles. Colonel Labre established two rubber stations, in 1884, at the mouth of the Curykethé, 200 miles from the Purus. Above the Curykethé the banks are higher and the ground more undulating than below. The colonel estimates the number of wild Indians living on this river and its affluents at 8000.

Africa.—Mr. Thomson's Travels in Morocco.—The January issue of The Proc. Roy. Geog. Soc. contains a map of South-Western Morocco, reduced from the field maps of Mr. Joseph Thomson, who spent a part of last year in its exploration. The object of Mr. Thomson's journey was not only to extend our knowledge of a country the greater part of which is unexplored, but also to trace the parent sources of the infant civilization of Central Soudan.

From Tangiers to the Wady Tensift, on the way to Mogador, the country is a gently undulating upraised sea-bed, nowhere rising above 500 feet, and crossed by only one stream, the Um-er-Rbia. Trees are absent and population scant. At the Tensift the area affected by the rising of the Atlas is reached, and the Tertiary gives way to Cretaceous lime-stones and shales, covered with a forest of the oil-tree called the "Argan," which lives where the olive cannot grow. Farther on, in the province of Shiedma, a crust of cemented calcareous particles practically seals up the soil from the husbandman.

From Mogador our traveler, with a party of men, returned to Saffi, and thence crossed the country to Morocco. The first part of the journey was over the raised sea-bed of Abda, the second over a higher step of the plateau called Bled Hammel, or the Red Country. The district of Rahanma, farther on, is composed of serrated ranges of denuded hills running parallel to the Atlas. The city of Morocco is in a great plain—the dried-up bed of an ancient lake. The first excursion was to the picturesque town of Demnat, situated in a most charming valley. A continuous boss or dyke of basalt marks for many miles the merging of the mountains from the plains. From Demnat excursions were made to the wonderful natural bridge-aqueduct of Iminifiri, and to Tasimset, south-west of Demnat. The great arch at Iminifiri is not only used as a bridge, but a stream which forms a cascade on one side of the gorge passes over it from its source on the other. From an elevation of 6000 feet near Tasimset it was evident that Cretaceous rocks not only formed the lower ranges, but the central mass of the Atlas. From Sidi Rehal, between Demnat and Morocco, a start was made for the higher peaks. After passing through glens with cliffs of red clays, red sandstone was reached. The pass of Tizi-n-Teluet was crossed at a height of 8381 feet. Compelled to turn back by the Kaid of Glauwa, the party followed the foot of the range south-westward, and the ascent of the Tizi Nemiri (9962 feet) was successfully performed.

Mr. Thomson had orders both from the Sultan and from the local Kaids not to venture into the mountains, and these orders seem to have been motived by a very reasonable desire for his safety, the mountain districts being semi-independent, and the natives jealous of intruders. Mr. Thomson was stoned, and had several narrow escapes from being shot. After a failure to ascend the gorge of the Urika, the Reraya glen was climbed, and the summit of Tizi Likunipt (13,151 ft.) was reached. Still later the end of the Atlas range was turned by the valley of a tributary of the Sus, the mountains of metamorphic rock rising to 6000 feet on one side, while on the other the Mtuga and Haha plateau of red sandstone rose only to some hundred feet.

Mr. W. B. Harris' Travels in Morocco.—Mr. W. B. Harris (Proc. Roy. Geog. Soc., Jan. 1889) gives an account of his visit in disguise to Sheshuan, a town some 60 miles south of Tetuan. The inhabitants are nearly all "Shorfa" or descendants of the Prophet, and it is death for a Christian to be discovered within the walls. Sheshuan is a walled town with seven mosques and five gates, its

houses are built around patios or courts and have red-tiled roofs, there is a solid masonry bridge, and civilization is higher than in many more accessible towns. Mr. Harris's escape was little short of miraculous, and was largely due to his faithful Arab boy. Sheshuan does not acknowledge the authority of the Sultan.

After his visit to Sheshuan, Mr. W. B. Harris traveled without disguise among the fanatical tribes of the north-west mountains of Morocco, without molestation, and with every possible care for his well-being. This immunity was, however, due to his acquaintance with H. H. Mulai Mohammed, the Sherif or religious chief of Wazan, whose authority is great among these tribes which do not acknowledge the sway of the Sultan. His account of his excursion, in the August issue of the Proc. Roy. Geog. Soc., is illustrated by a map, upon which the local distribution of these tribes is mapped, the authorities for correctness being not only Mr. Harris, but Mulai Mohammed himself. Round Tangier are the Al Fahs, further inland the three small tribes of Beni M'sor, Wad Dras, and Beni Dir. Beyond these the Beni Arros have some small cities on the upper mountains, which are all well wooded with wild olive and cork. Between Tituan and Sheshuan are the Beni Hamar near the coast, and the Ghamara, Beni Hassan, Riff, Beni Ghorfad, Sheshuan and Lakhamis. The Beni Hassan is the most powerful tribe named here, and the Riff are Berbers, not speaking Arabic. South of Fez are the Berber tribes of Beni M'Tir and Beni M'Gild, and west of it the Zarun and the Zimmuri. In the Zarun is the sacred town of Mulai Idris, and Mulai Yakub, famous throughout Morocco for the healing powers of its hot springs. Here also are remains of the Roman city Volubilis. North of Fez are the Beni M'squilda, the Beni Zaran, and the large and important tribe of the Beni M'sara. Mr. Harris discribes this tribe as being for the most part fair, with blue eyes and yellow beards, handsome and well-built. They told Mr. Harris that their objection to Christians was based on the fear that they were spies, and would some day come with an army to take the country, but that a friend of Mulai Mohammed was welcome. The hill tribes of this part of Morocco seldom marry according to the law, but kidnap girls, who have a good time, dressed in velvet and silks, and doing no work of any kind. These girls perform ballets, and uncover their faces, often remakably beautiful, even before strangers. In the wars which arise through this kidnapping the women take part. With Mulai Mohammed himself Mr. Harris visited Ajin in the Ghruneh country north of Wazan. The Helserif, Beni Isof, and Beni Udeh, are other tribes between Wazan and

Sheshuan. To a recent demand of the Sultan for payment of taxes the Beni M'sara replied that they would pay them in bullets made of pesetas if he would send his soldiers to collect them.

The French Slave Coast Possessions.—M. A. L. D'Albeca (*Revue de Géographie*, September, 1889) gives some precise information respecting the French establishments on the Gulf of Benin. These are, in French orthography, Ogoué, Grand-Popo, Agomé Séva, Togodon, Whydah and its dependencies, Kotonou and territory, Lake Denham, with its posts of Aouansori and Afotonou, the river Ouémé, the kingdom of Porto Novo, the river and factories of Addo; and are situated on the slave coast, between 0° 4′ W. and 0° 36′ E. lat. of Paris. The frontage is 150 kilometres, and the boundaries are the German settlement of Togo westward, and eastward the English settlement of Lagos. The ideal line of demarcation between Togo and these settlements is prolonged to 9° N. lat. Outlets for commerce are looked for towards the middle course of the Niger. The river Addo, navigable for 70 miles, divides the French possessions from Lagos. It is the natural way to Abeokuta and Oye, two populous native centres. Through the action of the *barré* or Guinea current, there has been thrown up a line of sandbanks of varying width, behind which extends a series of brackish lagoons. The factories are on this *cordon littoral.* The entire coast is an unbroken sandbank, with nothing to orient the mariner save coco trees and the low tower of the church of Agoué. North of Grand-Popo and Whydah is a series of terraces which terminate in a wall at some distance from the ocean. The lagoon of Agoué, running west to east, empties into that of Grand-Popo, at the confluence of the latter with the Agomé river. The last-named lagoon, after passing Grand-Popo, Hevé, Agogo, and other factories, empties itself into the sea by the Bouche du Roi, near Arihoué. The Aroh river becomes navigable before entering the Whydah lagoon, which now no longer communicates with Lake Denham. It now runs westward, receives the Aroh, and finally mixes its waters with those of the lagoon of Grand-Popo. The Ouemé forms the boundary between Porto Novo and Dahomey. The waters of this large river form Lake Denham, which communicates with the sea by the canal of Kotonou. The lagoon of Porto Novo communicates with Lake Denham, and is always navigable.

Europe.—Corsican Railways.—At the commencement of 1888, there was a department of France without a mile of railway in operation. The first lines, from Bastia to Corte, and from Casamozza to

Tallone, were opened on February 1. Yet Corsica has an area of 8747 square kilometres, and has been a part of France since 1769. Lack of means of communication has always hindered the development of this island; it has been difficult for the peasants to bring their produce into the towns. The topography of Corsica is peculiar. There are two systems of mountains: one, of granitic summits, rising to 2800 metres, and crossing the island transversely; the other, of stratified rocks, running north and south along the eastern coast. The streams which enter the sea on the western side, run at right angles to the coast, between high walls; those which flow eastward are among the mountains just mentioned, yet some unite to form the Golo and the Tavignano, the most important rivers of the island. Thus the basins are all independent, and hitherto there has been no force with power enough to link together the populations of the eastern and western coasts. The interior is a labyrinth of mountains. One climbs from village to village by *scale*, or ladder-like footpaths.

Eight national routes were planned, to surround the island and cross it diagonally; but only 403 kilometres of these roads are actually in good state. These roads were long ago found insufficient, and 440 kilometres were projected in 1878. The writer, M. Daniel Bellet, then describes the principal features along the two completed railways, and concludes by pointing out some of the advantages to commerce that will accrue from them.—*Revue de Géographie, June and July, 1889.*

Progress in Russian Geology.—A new sheet of the geological map of Russia covers the southern Urals. Contrary to current opinion, the great chain consists in its southern parts of a number of parallel chains, all running from southwest to northeast. The main water-parting is built up of granites, syenites and gneisses, considerably worn by denuding forces. Towards the east it has a steep slope, and its base disappears beneath the Tertiary, while toward the west it is overlaid by Devonian, Permian and Carboniferous, folded into parallel chains, rising more than 3300 feet above the sea. Farther west, the country is a plateau, built up of the nearly horizontal strata of a formation intermediate between the Permian and Carboniferous of Western Europe. Above this there are Triassic deposits.

M. Tchernysheff shows that the bituminous gray and dolomitic limestones of the Ural, once thought to be Silurian, and as a rule poor in fossils, are in truth lower Devonian. The same series of limestones, quartzites and shales, also arrayed in ridges running southwest to northeast, occurs in Siberia and Turkestan.

Another sheet of the map shows the region on the right bank of the lower Volga. Here upper Carboniferous strata occur only in the deeper ravines; the Cretaceous is represented by the Aptian and Neocomian of the lower Cretaceous, and by the Senomanian, Turonian and Senonian of the upper; but nearly the whole of the region is covered by Eocene clay and sands. Boulders are strewn over the surface in such a way as to cause Professor Sintsoff to conclude that the ice-sheet of Russia came down to the Volga under the fiftieth parallel.

Asia and Oceanica.—The Transcaspian Railway.—The Hon. G. Curzon, M. P., (Proc. Roy. Geog. Soc., May, 1889,) gives particulars of the history and construction of the great Transcaspian Railway, a train of which steamed, amid the roar of cannon and the playing of bands, into Samarkand on May 27, 1888. The road from Merv to the Oxus was made at the rate of from a mile to a mile and a-half a day. The average cost of construction, rolling stock and rails included, was £4500 per mile, but the cost on the spot did not exceed £2700. Most of the region traversed is flat as a billiard-table, and only three bridges: across the Tejmd, across the Murghab at Merv, and over the Amu Daria, were required in 900 miles. The chief difficulties arose from scarcity of water and superabundance of sand, and though the railway was built in spite of both, both will still be potent factors of expense and hindrance. Artesian wells were sunk, and failed; sea-water was distilled, but now water is taken to and fro in huge wooden vats attached to the trains, cisterns having been built wherever there is a natural supply. Most of the line is laid either on a solid argillaceous surface, with saline efflorescence on the top; or on a loose soil which nourishes camelthorn and other desert shrubs, and with irrigation would yield abundant crops. The shifting sands are limited to: (1) the first 30 miles from the Caspian; (2) the stretch between the Merv oasis and the Oxus, and (3) a narrow belt between the Oxus and Bokhara. Soaking the permanent way with sea-water, covering it with clay, driving light palisades into the tops of the dunes, and the planting of tamarisk, *Haloxylon ammodendron*, or saksau, etc., are among the means adopted to check the advance of this shifting sand over the line. All lighting is done with distilled petroleum. Daily trains run from the Caspian to the Oxus, twice a week beyond. Mr. Curzon then describes the principal points upon the railway, the course of which is, however, sufficiently familiar to the readers of the NATURALIST. He states that the crests, and even the valleys on the southern side of the crests, of the Persian border moun-

tains that skirt 300 miles of the railway, are in Russian hands. The railway will doubtless ultimately be extended to Tashkent, the Russian capital of Central Asia, 190 miles northeast of Samarcand. According to General Aurankoff, the constructive engineer of the Trans-Caspian Railway, there is no reason why a considerable portion of Transcaspia cannot be reclaimed for agriculture. A broad belt of loess, interrupted with sands in a few places only, stretches from Kyzylarvat to Askabad along the foot of the Kopet-dagh, and further east along the Abrek. Chemical analysis proves it identical with that of China. The Turcomans, who are the worst of agriculturists, get at Merv a return of 170 to 1. The barkans or sandhills are naturally covered with vegetation, among which the saksau is the best plant, and this and other plants have increased rapidly near the railway since the prohibition to cut bushes within three miles of the line. At Merv, in the last three months of 1885 and the first four of 1886, sixty-five inches of rain, above the average of Great Britain, was recorded. But there are no summer rains, and thus irrigation is necessary, and with the Amu Daria at Chardjui 27 miles wide, and flowing 6½ miles an hour, an irrigation canal sems quite possible.

The D'Entrecasteaux Islands.—The Louisiade and D'Entrecasteaux islands form the subject of a long article in the Proc. Roy. Geog. Soc. for September of this year by B. H. Thomson. The natives of Rossel look like hybrids between Papuans and Solomon Islanders. Short, robust, and sooty brown, with wide nostrils, flat nose, and prognathous face, they seem to be in a low state of savagery. The men's dress consists of a single pandanus leaf secured round the waist by a cord of human hair. The women wear grass petticoats. The cartilage of the nose is bored, and that of the ear enlarged, but tattooing is not practised. Stone axes have been discarded for iron blades picked up from wrecks, and inserted in stone axe handles. The pig and the dingo are the only domestic animals. Rossel is well timbered, and mountainous, rich in plants, and surrounded by a barrier reef. Joannet is flat, with a semi-circle of hills on the southeast. St. Aignan contains more than 100 sq. miles, and is thickly peopled. It has a range 3500 feet high, and no barrier reef.

Normanby Island is an L-shaped range of mountains, not exceeding ten to twelve miles in width anywhere, and containing about 350 square miles. There is much schistose slate with quartz veins, and in the north there is limestone, basalt, and porphyry. The natives are characteristically Papuan in dress and person. This island is the eastern

limit of the Wallaby, and also of the largest of the avian genus Manucodia. Ferguson Island, the largest of the D'Entrecasteaux, probably has 500 square miles, and its highest summit, Kilkerran, is 6000 feet. Goodenough Island has a range of mountains culminating in two peaks not less than 7000 feet high. The people proved quiet and friendly, and their houses, built on raised platforms, with curved roofs, and tapering from the end nearest the village square, are peculiar.

GEOLOGY AND PALÆONTOLOGY.

The American Association for the Advancement of Science.—Numerous valuable papers were contributed to the Geological Section (E) at the late meeting at Toronto. We are indebted to our correspondent, Prof. Joseph F. James, for the following notes on some of them.

Topographic Types of North-Eastern Iowa. By W. J. McGee.—This paper was illustrated by a relief map of the section treated of, which showed the different character of the drainage channels of the district. In the extreme northeast was the dendritic system. In the lower portion the most peculiar feature was that the streams, instead of following the valleys, followed the ridges, and in them had frequently carved deep cañons for themselves. The cause of this was that the glacial period had so filled the valleys with drift deposits that on the retiring of the ice the streams were compelled to seek new channels, and these were easiest found along the ridges.

Glacial Phenomena of Northern Indiana and North-eastern Illinois. By Frank Leverett.—The writer detailed his investigations in the region in question, and mentioned in particular the moraines which he had followed in their windings. He mentioned one moraine which was so obscured that it was only by careful barometeric measurement that its presence could be detected. A profile, however, showed plainly the morainic character, with a long, gradual slope on one side, aud an abrupt one on the opposite. The lobations of some of the moraines were described, and mention made of the very different directions from which the materials were derived, even within a small area.

"*The Attractive Scenery of Our Own Land,*" was the title of a paper by Prof. A. S. Bickmore. In this the author described the

scenery of the Northern and Canadian Pacific railways, dwelling in particular upon the beauties of the peaks of the Rocky mountains, with their perpetual snows and living glaciers. He entered an earnest plea for the study of the scenery of this continent, as opposed to that of Europe. In the one case we have Nature in all her freshness, while in the other man's presence has thrown a glamor over the scene.

On certain remarkable new fossil plants from the Erian and Carboniferous, and affinities of the Palæozoic Gymnosperms. By Sir. Wm. Dawson.—This was an interesting paper, in the course of which the author reviewed the main features of living gymnospermous plants and mentioned their affinities with other classes. Mention was made of a remarkable fossil found by R. D. Lacoe, of Pittston, Pa., to which the name *Dictyocordaites Lacoei* was given. The specimen in question showed certain features which had previously been supposed to belong to several distinct genera, and it was thus the means of uniting them under one name. Various other specimens were mentioned which seemed exactly intermediate between distinct genera. To one of these the name of *Tylodendron* was given. The existence in Palæozoic times of a large series of gymnospermous plants was dwelt upon, and the idea advanced that from the highly developed Gymnosperms of the Palæozoic were developed, on the one hand the Acrogens, and on the other the Phanerogams, while the predominant family of that early time has degenerated into the meagre representation of our modern cycads and conifers. Although not an avowed evolutionist, Sir William has put a powerful weapon into the hands of working biologists by his description of the new intermediate or generalized forms mentioned in his paper.

Mammoth Cave. By H. C. Hovey.—In this paper reference was made to the extent of the cavern, and to the fact that it is in several tiers or galleries, and that these have been cut through in places by the action of water. What appear pits at one level become domes in the one below. Mention was made of the discovery of several new pits, in the vicinity of what is commonly called the "Bottomless" pit. Some other name must be found for this, as its depth has been sounded, and is found to be ninety-five feet. Late explorations have revealed the fact that Scylla, Charybdis, the Bottomless, Covered, and four other pits, are all connected together at the bottom, and are there united into a large hall several hundred feet in length, to which the name of "Harrison's Hall" has been given. The paper was illustrated by a large map and several diagrams of special portions of the cave.

Section of Makoqueta Shales in Iowa. By Joseph F. James.—In this paper mention was made of the locality where the typical exposure is to be found. It is near Lattner's Post-Office, reached from Graf, a station on the Chicago, St. Paul and Kansas City railroad, sixteen miles west of Dubuque. Details of the section were given, and mention made of the fossils found in the shales. A species of Orthoceras is especially abundant, and remarkable for its wonderful state of preservation, many specimens retaining their original pearly nacre. Groptobites were also finely preserved, and very abundant in certain layers. The junction of the shales with the Galena below was mentioned as having been observed.

Geology of Borneo.—Dr. T. Posewitz has published the results of three years' personal explorations in Borneo, and in the second part of his work deals with the geological and physical structure of that large island. There is no uninterrupted central mountain chain, but isolated mountains surmount table-lands which extend northeast to southwest. As far as is known, the Kina Balu mountains, which have a maximum height of 13,698 feet, are the highest. The geological structure is simple. The isolated mountains are slate or schist, penetrated by granite and diorite. Succeeding these are Devonian strata with auriferous veins. Within the last few years Carboniferous strata (mountain limestone) have been found, and are believed to occupy a wide area in north Borneo; and Cretaceous rocks have been found in a single locality in west Borneo. The Tertiary is spread over wide areas, and forms the plateaus through and over which the mountains rise. The older Tertiary includes sandstone, marl and limestone, and the greater part of the coral deposits occur in the sandstone. The older Tertiary strata are often much disturbed and broken by intrusive masses of andesite. Oligocene strata are only known in East Borneo, and include extensive deposits of coal.

Diluvium spreads over wide undulating tracts around the Tertiary hills, and contains the principal sources of the gold and diamonds of the island. There are no evidences of any post-Tertiary volcanic energy.

Geology of Tasmania.—R. M. Johnson, F.L.S., has published a systematic account of the geology of Tasmania, with a sketch map on a scale of fifteen miles to the inch. The oldest formations are in the west and northeast, and consist of crystalline schists, apparently Archæan, with clay slates, quarzites, sand stones and limestones of Cambrian, Ordovician or Silurian age, with small and doubtful evidences

of Devonian. Between the two are as of older rocks a tract of great extent, in the centre of the island, is occupied by coal-bearing strata. The lower series of these contains plants of Carboniferous age, but the higher coal-measures yield many plants of Mesozoic affinities. These strata have been invaded by igneous intrusions, and are to a great extent covered by Tertiary beds.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—A new type of rock has been discovered by Mr. Arnold Hague[2] in the Absaroka Range, Wyoming Territory. It was found as a boulder in the gorge of the Ishawooa River. The most striking feature of the rock is the number and size of the grains of fresh olivine scattered through it, the only other macroscopical ingredient being augite. These two minerals lie in a ground-mass composed principally of *leucite* and orthoclase, together with a small amount of plagioclase, magnetite, apatite, and minute flakes of brown mica. The rock is particularly interesting as the third occurrence of a leucite rock in North America. The leucite is partly idiomorphic and partly allotriomorphic. Some of its crystals are isotropic, while others show optical anomalies. A number contain minute augite grains as inclusions, arranged centrally or in a spherical zone about the centre of the crystal. An analysis of the rock reveals a very low percentage of potassium, a percentage so low as to suggest the existence of such conditions during the solidification of the rock as to allow of crystallization in two very distinct stages. The analysis was made by Mr. Whitfield.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	Cl	P_2O_5	H_2O
47.28	.88	11.56	3.52	5.71	.13	9.20	13.17	2.73	2.17	.18	.59	2.96

——Two new localities for camptonite have been reported from the New England States within the past summer. The first is near Whitehall, Washington Co., N. Y., where Messrs. Kemp and Marsters[3] discovered dykes cutting the Georgia slates. In addition to the usual features of

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Amer. Jour. Sci.*, July, 1889, p. 43.

[3] *American Geologist*, Aug. 1889, p. 97.

camptonite, the rock from this locality possesses porphyritic zonal augites with inclusions of brown hornblende crystals, similar to those constituting the most abundant constituent of the rock. The rock also possesses amygdaloidal cavities filled with calcite. The second locality is made known by Mr. F. L. Nason.[4] It is a rock-cut on the Rutland and Burlington R. R. near Summit, Vt. The rock is almost identical in appearance with dyke No. 2, of Dr. Hawes.[5]——Prof. F. D. Chester[6] regards the serpentine of Chester Co., Pa., as having been derived from a bronzite-diallage rock through the alteration of the bronzite to tremolite, upon its contact with a dark green hornblende. The original rock is of a slightly fibrous character, composed of a ground-mass of green hornblende, diallage, a little olivine and magnetite, in which are phenocrysts of bronzite prismatically elongated. This hornblende surrounds and includes the bronzite. In both minerals, as alteration has proceeded, the original characteristics gradually disappear, and in their place appear those of tremolite. Enstatite-gabbros and gabbro-diorites are also described. The latter rock is thought to owe its origin to the dynamic metamorphism[7] of the former. ——The rock occurring in eruptive bosses in northwestern New Jersey has been examined by Mr. Kemp[8] and found to correspond with Rosenbusch's biotite-augite-porphyrites. The plagioclastic ingredient is probably near anorthite in composition. The composition of the biotite is:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss.
34.61	15.74	8.52	tr.	20.03	17.14	tr.	2.8

Apatite is a very abundant constituent of all specimens.——The staurolite of a staurolite-mica-schist in the neighborhood of a mass of granitite, lying to the north of Saint-Étienne, France, is thought by Ternier[9] to be older than the metamorphic minerals found in the same rock. He believes it to be original, and in no way connected with the presence of the plutonic rock in its vicinity. Tourmaline in the same rock owes its presence to the influence of the granitite.

Mineralogical News.—Becker[10] proposes to simplify the view held as to the relations existing between the silicic acids found in

[4] *Amer. Jour. Sci.*, Sept. 1889. p. 229.
[5] Ib. CXVII, p. 147.
[6] 2d. Geol. Survey of Penna., Annual Rep. for 1887, p. 93.
[7] cf. AMER. NATURALIST, Dec. 1886, p. 1049.
[8] *Amer. Jour. Sci.*, Aug. 1889, p. 130.
[9] Bull. Soc. Franç. d. Min., XII., p. 393.
[10] *Amer. Jour. Sci.*, Aug. 1889, p. 154.

silicates, by regarding meta-silicic acid as as a union of ortho- and poly-silicic acids ($H_4SiO_4 + H_4Si_3O_8 = 4H_2SiO_3$), and di-silicic acid as a poly-silicic acid from which ortho-silicic acid has been separated ($3H_4Si_3O_8 - H_4SiO_4 = 4H_2Si_2O_5$). The advantages of this view, as suggested by the author, are found in the discussion of the decomposition of natural silicates, and in the study of isomorphism in long series of isomorphous substances like the feldspars, and in the di-morphism of many groups of silicates. The amphiboloids, for instance, being meta-silicates, their dimorphism may be explained by supposing the base in the one case to replace the hydrogen in the ortho-acid, while in the other it may be supposed to be united with the residue of the poly-acid. According to this view all silicates may be regarded as salts of ortho- or of poly-silicic acids or their combinations.——The iron sulphates of Chili are at present the subject of careful work by chemists in this country and abroad. The investigations of Frenzel [11] and G. Linck [12] have already been noticed. Recently Mackintosh [13] has published notes and analyses of *coquimbite*, *copiapite*, *roemerite*, *amarantite*, and a few other substances with apparently definite compositions. A pulverulent flaky orange-colored substance associated with copiapite and amarantite has a composition corresponding to $(FeO)Fe.(SO_4)_2 + 4H_2O$. White pulverulent decomposition products of the above mentioned minerals are basic iron sulphates and combinations of ferrous sulphate with the corresponding sodium compound. Among the minerals described by the author is one to which he has given the name *ferronatrite*. This mineral occurs in stellate groups of a pale green color, forming nearly spherical nodules, like wavellite. It is soluble in water, and has the composition:

SO_3	Fe_2O_3	Al_2O_3	Na_2O	K_2O	SiO_2	H_2O
50.25	17.23	.43	18.34	.40	2.00	11.14

corresponding to $Na_3Fe(So_4)_3 + 3H_2O$. —— In the Archæan limestone of Macomb, St. Lawrence Co., N. Y., Mr. Kunz [14] has discovered a cave whose walls are lined with crystals of sea-green *fluorite*, forming groups weighing from ten to several hundred pounds. Attached to the fluorite are small masses of *lithomarge*, and imbedded in these are very perfect tetrahedral crystals of *chalcopyrite*. A water-worn fragment of *fire-opal* is mentioned by the same author as having been

[11] cf. AMER. NATURALIST, 1888, p. 1022.

[12]

[13] *Amer. Jour. Sci.*, Sept. 1889, p. 242.

[14] *Amer. Jour. Sci.*, July 1889, p. 73.

found in Crook Co., Oregon, and a *diamond* in Russell Co., Ky. The diamond weighs 7-16 carats. It was found on the top of a gravel hill, and is an elongated hexoctahedron, with rounded faces.—Almost all *epidote* crystals, as is well known, are elongated in the direction of their ortho-axes. Dr. Bodewig,[15] in America, and Artini, in Italy, have recently described crystals with a normal development, *i.e.*, with a prismatic habit, with the long direction parallel to the vertical axis. The American mineral was bought at the foot of Pike's Peak. The European specimen came from Elba.——Crystals of the hyacinth variety of *quartz*,[16] occurring in the saliferous clays in the Basses-Pyrénées district of France, contain numerous inclusions of *anhydrite* arranged zonally.——Both Rammelsberg [17] and Meyer [18] have concluded, as the result of independent chemical examination, that the substance described as *jadeite* by Fellenberg [19] is nothing more than *vesuvianite*. ——As the result of a recalculation of the analyses found scattered through the literature of the natural sodium carbonates, and the light thrown upon these by some new analyses of salts produced by the solar evaporation of the waters of Owens Lake, Cal., Dr. Chatard [20] concludes that the substance known as *trona* ($Na_2CO_3 + 2\ NaHCO_3 + 3\ H_2O$) does not exist, either as a mineral or as an artificial compound, whereas all the published analyses of the natural carbonate, as well as those of the compound produced by artificial evaporation of mixed solutions of the carbonates, yield figures that correspond very closely with the composition of *urao*, a mineral described by Faxar,[21] and by Boussingault,[22] from Venezuela.——Bücking [23] has made a very thorough examination of the *glaserite*, *blödite* (*astrakanite*), *kainite*, and *boracite* crystals from the salt beds at Douglasshall, near Westeregeln, in the Stassfurt salt regions. The glaserite is in small, nearly colorless crystals, with a hardness of 2.75-3, and a specific gravity 2.632–2.656. They crystallize in the hexagonal system, with $a : c = 1 : 1.2879$, and usually have a rhombohedral symmetry, although individuals with an orthorhombic symmetry are not rare. Their refraction is positive with $\omega = 1.4907$ and $\varepsilon = 1.4993$. Its composition corresponds approximately to the formula $3K_2SO_4 + Na_2SO_4$. The kainite is also in small crystals, with

[15] *Amer. Jour. Sci.*, Aug. 1889, p. 164.
[16] Beaugey: Bull. de la Soc. Franç. de Min., XII., p. 396.
[17] *Neues Jahrbuch für Mineralogie, etc.*, 1889, I., p. 229.
[18] Ib. 1889, I., p. 270.
[19] cf. AMER. NATURALIST. March, 1889, p. 158.
[20] *Amer. Jour. Sci.*, July, 1889, p. 59.
[21] *Annals de Chemie*, II., II., p. 432.
[22] Ib. II., xxix., p. 110.
[23] *Zeits. für Kryst.*, xv., 6., p. 561.

a cleavage parallel to $\infty P\bar{\infty}$. The axial ratio is $a : b : c = 1.2138 : 1 : .5862$. $\beta = 85°$. The boracite is found in carnallite layers. It occurs in small colorless or light green crystals that are combinations of the cube and tetrahedron, with occasionally dodecahedral and other faces. The new planes

$$\infty O 4, \left(\frac{4O}{2}\right), -\left(\frac{\infty O}{2}\right) \text{ and } -\left(\frac{16O}{2}\right)$$

were observed.

Rare Minerals.—*Mazapilite*, described by Dr. König,[24] proves[25] to be a calcium-iron arseniate, with the composition :

As_2O_5	Sb_2O_5	P_2O_5	Fe_2O_3	CaO	H_2O
43.60	.25	.14	30.53	14.82	9.83.

It crystallizes in the orthorhombic system, has a prismatic habit, and a specific gravity of 3.582.——*Uraninite.*—In a preliminary notice, Mr. Hillebrand[26] announces the presence of nitrogen in uraninite, in such combination as to yield the free gas upon treatment with an acid. He adds also that all specimens of this mineral examined, with the exception of one from Bohemia, are found to contain thoria or zirconia.——*Plattnerite*, the rare lead di-oxide, is described by Wheeler,[27] and by Messrs. J. D. and E. N. Hawkins[28] as occurring in a lead mine in Shoshone county, Idaho. The specimens examined are black. They have a hardness of 5–5.5, and a fusibility of 2. Analyses show that the mineral contains between 91 and 96.63 per cent. of PbO_2.——*Gyrolite* occurs as a colorless, fibrous layer lining the walls of an apophyllite vein at the New Almaden Quicksilver Mine, in California. Its composition, as determined by Prof. Clarke,[29] is :

SiO_2	Al_2O_3. Fe_2O_3	CaO	K_2O	Na_2O	F	H_2O
52.54	.71	29.97	1.56	.27	.65	14.60

[24] AMER. NATURALIST, Feb., 1889, p. 173.

[25] Proc. Acad. Nat. Sci., Phila., 45., 1888–9.

[26] *Amer. Jour. Sci.*, Oct., 1889, p. 329.

[27] *Amer. Jour. Sci.*, July, 1889, p. 79;

[28] ib., Aug., 1889, p. 165.

[29] *Amer. Jour. Sci.*, Aug., 1889, p. 128.

BOTANY.

Botany at the A. A. A. S.—The recent meeting of the American Association for the Advancement of Science, was notable in the activity of the botanical part of the section of Biology. The attendance of working botanists was unusually large, although the faces of many well known men were missed in the meetings. Among those present may be mentioned: Professor J. C. Arthur, of Purdue University; Dr. T. F. Allen, of New York City; Professor T. J. Burrill, of the University of Illinois; Professor W. J. Beal, of the Michigan Agricultural College; Professor N. L. Britton, of Columbia College; Professor D. H. Campbell, of the University of Indiana; David F.Day, of Buffalo; Professor W. M. Dudley, of Cornell University; Professor G. L. Goodale, of Harvard University; B. T. Galloway, of the Botanical Division of the U. S. Department of Agriculture; Professor B. D. Halsted, of Rutgers College; Professor J. F. James, of the U. S. Geological Survey; Professor W. R. Lazenby, of the University of Ohio; Thomas Meehan, of Germantown, Pa.; John Macoun, of the Canadian Geological Survey; Professor T. H. McBride, of the University of Iowa; and Professor F. L. Scribner, of the University of Tennessee.

In the meeting of the Society for the Promotion of Agricultural Science, which preceded the meeting of the Association, several papers were read upon botanical subjects, as follows:

J. C. Arthur.—What is Common Wheat Rust?

W. J. Beal.—A Study of Birdseye Maple.

C. E. Bessey.—The Grass Problem in Nebraska.

T. J. Burrill.—A Bacterial Disease of Indian Corn.

B. D. Halsted.—The Cranberry Gall Fungus.

B. D. Halsted.—Our Worst Weeds.

The Botanical Club of the Association, under the management of its Chairman, Professor Burrill, and Secretary, Professor Campbell, held meetings every morning, at nine o'clock, in the room assigned to Section F, and took part in a most enjoyable excursion, on Thursday, to Scarborough Heights, on the shore of Lake Ontario, in quest of rare specimens.

In the sessions notelets were read upon The Fertilization of *Hypericum canadense*, and The Cleistogamy of *Cerastium nutans*, by Thomas Meehan; The Pollen of *Pontederia cordata*, and The Explosive pods of the Wild Bean, by B. D. Halsted; Certain Additions to the North

American Flora, The Occurrence of a Siberian Labiate (*Elsholtzia cruciata*) in Canada, a notice of Dr. Morong's South American Work, and a description of a new genus of Vacciniaceæ from Brazil (Rusbya), by N. L. Britton; The Work of the Botanical Division of the U. S. Department of Agriculture, by F. V. Coville; On the Occurrence of Chlorophyll, in the Embryo of *Celastrus scandens*, Studies in Nuclear Division and The Culture of Aquatics in the Laboratory, by D. H. Campbell; The Management of a South Exposure for the Laboratory, by J. C. Arthur. The veteran Canadian collector, John Macoun, discussed methods of work in the field, in which he stated that he had long since abandoned the use of the tin collecting box, using instead a portable press supplied with strong straps, and into this he places his specimens at once as found.

Dr. N. L. Britton was elected President for the ensuing year, Professor F. L. Scribner, Vice-President, and Professor Charles R. Barnes, of Madison, Wis., Secretary.

At the close of the meeting resolutions were adopted urging the governing body of the University of Toronto to favor the plans of Professor Wright for the establishment of a Botanic Garden upon the University grounds.

In the meetings of Section F, the best paper was the address by Vice-President Goodale, in which he gave a summary of the recent advances in our knowledge of protoplasm and the anatomy of the vegetable cell. This address created much enthusiasm, and gave strength to the movement which finally resulted in the election of Dr. Goodale to the presidency of the Association.

Of strictly botanical papers read in the daily sessions there were twenty, as follows:

J. C. ARTHUR.—"A Bacterial Disease of Carnations," in which the author announced the discovery of a new micrococcus which produces one of the common diseases of carnations.

W. J. BEAL.—"Notes on Seedlings of *Elymus virginicus*," noting the fact that glaucousness appears to be hereditary in this species.

W. J. BEAL.—"Notes on Bird's-Eye Maple," illustrated by specimens, reaching the conclusion that the "bird's-eye" structure is due to some previous injury.

N. L. BRITTON.—"On the Genus Eleocharis in America," "On the Tropical Distribution of Certain Sedges," "On the Flora of New Jersey," "The New Botanical Laboratory of Barnard College."

T. J. BURRILL.—"A Bacterial Disease of Indian Corn." The affected plants are smaller, yellow and slender. The bacteria are slightly

elongated, usually paired, and take a marked polar stain, with a broad hyaline equatorial belt.

T. J. BURRILL.—"Fermentation of Ensilage." This appears to be due to *Bacillus butyricum*, a motile bacterium, which is capable of reproducing rapidly in the high temperature of the silo.

F. V. COVILLE.—"Revision of the United States Species of Fuirena."

DAVID E. DAY.—"An Observation on *Calamintha nuttallii*," noting certain suggestive variations, or reversions.

WM. R. DUDLEY.—"A Suggestion concerning Scientific Work," urging that attention be given to the study of the Fresh-water algæ, which possesses economic as well as scientific interest.

G. L. GOODALE.—"On a Convenient Method of Subjecting Living Cells to Coloring Agents."

B. D. HALSTED.—"Reserve Food-substances in Twigs," showing by means of drawings the distribution of the starch in twigs of various kinds.

B. D. HALSTED.—"Notes upon Stamens of Solanaceæ."

THOMAS MEEHAN.—"On the Position of the Nectar Glands in Echinops," "On the Epigynous Gland in Diervilla, and the Genesis of Lonicera and Diervilla," "On the Assumption of Floral Characters by axial growths in *Andromeda catesbæi*," "On the Significance of Dicœcism as illustrated by Pycnanthemum."

F. L. SCRIBNER.—"The Grasses of Roan Mountain."

In the foregoing list it is impossible to give the substance of the papers without taking more space than we have at our command. This general remark can be justly made, that while there were a number of first-class papers, there were far too many short notes and isolated observations, which ought to have appeared in the Botanical Club, rather than in the Biological Section of the Association.

In order to secure, if possible, a higher grade of papers, the following resolutions were adopted:

Resolved, That one of the topics for discussion by Section F, at the meeting in 1890, shall be "The Geographical Distribution of North American Plants."

Resolved, That the following appointments be made of members of Section F, who shall be requested to prepare papers upon special parts of the general topic of the Geographical Distribution of North American Plants, viz.:

SERENO WATSON.—"The Relation of the Mexican Flora to that of the United States."

JOHN MACOUN.—"The Ligneous Plants of the Dominion of Canada."

JOHN M. COULTER.—"The Distribution of North American Umbelliferæ."

L. M. UNDERWOOD.—"The Distribution of North American Hepaticæ."

B. D. HALSTED.—"The Migration of Weeds."

N. L. BRITTON.—"The General Distribution of North American Plants."

The present secretary of the section is requested to give formal notification of the persons named, and the secretary of the section for 1890 is hereby requested to give such attention to this matter as may be necessary to perfect the proposed programme by correspondence, and through the circulars of the permanent secretary of the Association.

The next meeting will be held in Indianapolis, beginning August 21.

CHARLES E. BESSEY.

ZOÖLOGY.

The Doctrine of Phagocytes.—The interest excited by the ingenious hypothesis of Metschnikoff is shown by the number of experiments made and the articles written in support or contradiction of the assumption that the mesodermal cells of the Vertebrata inherit the capacity of absorbing and destroying pathogenic bacteria from their ancestors, the unicellular Amœbæ, the mesodermic cells of Cœlenterata, Turbellaria, etc. The summary of Dr. H. Bitter's recent critique of the evidence *pro* and *con* is thus presented by the *Journal of the Royal Microscopical Society.*

Unicellular lower animals, amœbæ, and also the mesodermic cells of sponges, take up small plants into their protoplasm, and digest them. In more highly organized animals this intracellular digestion becomes extracellular and fermentative; certain cells, however, still possess a capacity for picking up and dissolving foreign bodies. This contrivance is regarded by Metschnikoff as a special arrangement whereby harmful elements, especially pathogenic organisms, are prevented from penetrating the animal economy, the process being complicated by the resistance made by the parasite to digestion. Those cells which are able to digest foreign bodies are called phagocytes, and are farther subdivided into large and small. Infectious diseases are recovered

from when the phagocytes overmaster the exciting causes, and immunity after one attack or after inoculation depends on the phagocytes having become accustomed to combat the micro-organism.

This theory is supported by Metschnikoff's observations on Daphniæ which are attacked by a Torula with needle-like ascospores. These latter having been swallowed penetrate the tissues; as soon as this happens a leucocyte appears, and the spores are enveloped and destroyed. If the spore remain unattached and germinate the animal is infected. In frogs, too, anthrax bacilli are taken up by leucocytes and destroyed. At a temperature of about 30° Cent. only a few leucocytes take up the bacilli, and the animals become infected. This is explained on the hypothesis that the anthrax bacilli are more potent at this temperature, owing to their being accustomed to dealing with warm-blooded leucocytes [in the sheep]. In warm-blooded animals Metschnikoff rarely found bacilli in the leucocytes, but if the animals had been protected by a weakened virus the bacilli were picked up in quantities and destroyed. Hence it is concluded that immunity is derived from the leucocytes having got used to the poison of the bacteria.

Bacteria-eating phagocytes were also found in erysipelas and relapsing fever, and are also assumed to be present in gonorrhœa, leprosy, and tuberculosis.

According to Hess, the phagocytic privilege is shared by the cells of the splenic parenchyma, and of the liver, and Ribbert asserts that the spores of various kinds of Aspergillus and Mucor are got rid of in a similar manner. If, however, many spores be injected, the number of leucocytes may not suffice to prevent their development, and this last-mentioned author also believes that the viability of the fungi is diminished by the leucocytes cutting off the supply of oxygen. Other facts in support of the theory are, that if an animal survive the introduction of a small quantity of spores, there will be found, on a second injection, a much larger number of leucocytes, and that, as stated by Lubarsch, anthrax bacilli killed by boiling are not so quickly taken up by leucocytes in the frog as when injected in the living condition.

Against the theory are ranged numerous writers and experimenters, among whom may be mentioned Baumgarten and Weigert, who, while accepting the data, doubt the interpretation of the facts and the correctness of the hypothesis. Experiments made by C. D. Holmfield showed that only a few bacteria were taken up by leucocytes, and that the greater number of bacteria were destroyed outside the cells.

Emmerich gives similar results; thus after inoculating rabbits with erysipelas he found that this conferred a certain immunity against subsequent inoculation with anthrax, and also that the destruction of the bacteria was chiefly extracellular, and that the phagocytes made away chiefly with the dead bacilli. Again it is noticed by the author (H. Bitter) that in none of Metschnikoff's works, nor in those of other writers, is it certainly proved that the bacteria are destroyed by phagocytes, and by these alone, and in conjunction with Nuttall he has proved this experimentally.

With regard to Metschnikoff's experiments on frogs at high temperatures, it is obvious that the fluids of the body may become so altered by the increased heat that this fluid is thereby no longer able to weaken the bacteria.

Moreover, a series of observations has shown that anthrax bacilli have always suffered some damage before they became a sacrifice to the phagocytes. On the whole the author inclines to bring in a verdict of not proven.

Physalia in the Bay of Fundy.—In the published lists of Medusæ from Grand Manan, there is no mention of the well-known Portuguese-Man-of-War, *Physalia arethusa*. I am unaware that it has ever been taken from the Bay of Fundy, and up to last summer it was unknown to the fishermen who work in these waters.

During the last summer (August, 1889) several specimens of this interesting Gulf Stream jelly-fish were taken off Grand Manan and brought to me for study. I have also learned that many others have been seen in different parts of the Bay. This unusual appearance of these visitors from the tropics is connected with the great abundance of these animals all along the New England coast during the past summer. Its presence at Grand Manan, where the pelagic fauna is decidedly Arctic, is an interesting fact, as showing how far it may straggle from waters more congenial to its life. In this connection it may not be out of place to mention the fact that these Physaliæ were taken near the "Ripplings," tide eddies several miles off the west coast of Grand Manan, in which is collected at certain times of the tides a most wonderful abundance of free-swimming life. These eddies, which are feeding grounds for many of the larger marine animals, are peopled by a rich variety of marine life of all kinds, brought into its vortices by the extraordinary tides for which the Bay of Fundy is famous.—J. Walter Fewkes.

Myxine: a Protandric Hermaphrodite.—True males are extremely rare in Myxine. Out of several hundred specimens examined, I have recognized only very few males, and even those were unripe. The male organs are usually easy to distinguish from the ovaries; they are generally lobate, have a milky whitish color—especially in somewhat mature state—whilst the ovaries are more translucent. Small nodules are visible in both, but the nodules of the testes (*i.e.*, the sperma-follicles) are smaller and whiter than the nodules of the ovaries (*i.e.*, the young ova). In quite an early stage there is, however, little difference between testes and ovaries: they have the same translucent appearance, and are developed only on the right side of the straight intestine. As stated by previous authors, the testis as well as the ovary is secured by a membrane (mesorchium mesoarium) to the mesentery at the point where it is fastened to the intestine.

The minute structure of the male organs will subsequently be described, but we will first examine their occurrence and extension. A feature which attracted my attention on the first superficial examination of the testes of the few true males I had been able to recognize was, that the testes were usually much more developed and prominent at their posterior than at their anterior end. The reason of that I could for some time not discover; it will subsequently be seen that I have, perhaps, traced the cause.

But why do the males occur so extremely seldom? Before we attempt to solve this question, let us discuss the generative organs of the large number of Myxine which were recognized not to be true males. On opening large specimens of Myxine, we generally find well developed ova in their sexual organs. If we, however, take smaller specimens of 28 to 32 cm. in length, and examine their sexual organs, we generally find that the anterior portion is but slightly prominent, and contains very small and young ova, whilst the posterior portion is often very broad and prominent, is lobate, and has a distinct whitish color along its margin, and has, in all respects, the appearance we would expect to find in a testis; and this it really is. If we take a piece of the margin of this portion of the generative organ, tease it, and examine it in the fresh state under the microscope, we generally find abundance of spermatozoa in various stages of development There can thus be no doubt then that that portion of the generative organ is a real male organ. It is, indeed, strange that Cunningham has so little succeeded in finding spermataozoa. Those young specimens of 28–32 cm. in length are consequently hermaphrodites, with quite immature ovaries

but well developed testes, and they must be able to perform male functions.

If we now examine, somewhat more minutely, the generative organ of the large specimens, which generally contains a number of large and well-developed ova, we find that those ova occur only in the anterior portion of the generative organ, and that the mesoarium of this portion is very broad and prominent, whilst the membrane corresponding to the mesoarium of the posterior part of the generative organ is very narrow, and carries no reproductive elements, neither ova nor spermatozoa.

If we examine specimens of Myxine, of sizes between that of these large females and that of the hermaphrodite previously mentioned, we will often find specimens in which the anterior portion of the generative organ is rather prominent, and contains oblong young ova, whilst the posterior portion is of testicular nature and not very prominent. These specimens seem, consequently, to be in a transitory state between male and female states. Indeed, on examining a sufficient number of specimens, we will easily be able to find every transition stage from hermaphrodite males to fully developed females; and the rule seems to be that the larger the specimen is, the more are the female organs developed, and the more do the male organs disappear.

From what has been stated above, we seem already entitled to conclude, that Myxine is generally or always (?) in its young state a male; whilst at a more advanced age it becomes transformed into a female. Indeed, I have not yet found a single female that did not show traces of the early male stage.

Upon the whole, it must be admitted that there is a strange irregularity in the occurrence and extension of the male and female organs in Myxine. Myxine seems to me to be an animal which, in sexual respects, is just at present in a transition stage; from what and to what it is, however, not easy to say. It seems still to be seeking, without yet reaching, that mode of reproduction which is most profitable for it in the struggle for existence.—Fridtjof Nansen, *in Bergen's Museums Aarsberetning for 1888.*

Birds Killed by Electric Lights at Girard College, Philadelphia.—During the spring and fall migrations of birds many dead birds are seen near the electric towers in the grounds. In the last three weeks quite a number have been found, though not so many as last year, when a whole flock struck the electric tower at Ridge and South College avenue, in their migration to their winter quarters to the South.

It is now an established fact that most birds migrate at night, and during a dark stormy one they are more likely to be attracted by the electric light.

Among those dead or crippled were the Whip-poor-Will, *Caprimulgus vociferus* (a very rare bird with us), pewee fly catcher, *Sayornis fuscus*, American robin, *Turdus migratorius*, Maryland yellow-throat, ground warbler, *Trichas marylandica*, brown tree creeper, *Certhia familiaris*, wood thrush, *Turdus mustelinus*, white-breasted nut-hatch, *Sitta carolinensis*, hermit thrush, *Turdus solitarius*, song finch, *Melospiza melodia*, sometimes called song-sparrow.

Many woodpeckers and tree creepers are in the grounds at present, more than were ever noted before.

The downy woodpecker is busy at work making his ring of holes around the *Ulmus ruba*, red elm. The tree creepers have been his faithful assistants, though not having the power to make the holes he does. Both, no doubt, have done much good in ridding the grounds of the eggs and larva of worms that feed on the trees.

The barn owl, *Strix americana*, has put in an appearance this fall (a whole family of them). They are rare in Girard College grounds.

Quite a number of kinglets and viroes, or greenlets, were seen, but they were too shy to be approached, so they could not be named.

The Towhe ground-finch, *Pipilo erythropthalmus*, has also paid us his visit and departed. By the length of his name he might have paid us a longer one.

The fox-colored finch, *Passerella iliaca*, and many other birds of all the species above spoken of as killed, were also seen flying around, except the Whip-poor-Will.—F. H. DANENHOUR.

Zoological News.—Cœlenterata.—The greater portion of Vol. XXXI. of the Challenger Reports is occupied by E. P. Wright's and Th. Studer's account of the Alcyonaria, the Pennatulacea excepted. This report extends to 386 pages and 49 lithographic plates. All the Alcyonaria save the small family Haimeidæ, which may be primitive, tend to produce colonies by gemmæ. The Gorgonacea, in which a large number of individuals are so distributed that each receives an equal share of the nutritive supply, and favored also with a supporting skeleton, are regarded as the highest of the class.

Vermes.—*The Archiv für Naturgeschichte* for 1887, issued August 1886 (1 Band, 2 Heft) has a notice upon the fauna of Spitzbergen by Dr. W. Kükenthal, giving the results of a voyage undertaken in 1886. The work of description is divided between Dr. Marenzeller, who

takes the annelida; Dr. E. Meyer, the terebellina; Dr. Trautzsch, the polynoidæ; Dr. Kükenthal, the opheliidæ; Dr. Cobb, who describes the parasitic nematodes; Dr. Vosseler, who works out the amphipods and isopods; Dr. Giesbrecht, who describes the copepoda, and finally Dr. Kükenthal, who gives notice respecting *Hyperoodon rostratus* and *Beluga leucas*. A new polynoid is *Harmethoë vittata;* and an *Ammotrypane*, two forms of Ascaris (one from the Beluga, the other from *Phoca barbata*), and a Strongylus from the beluga are described. The number of new amphipods is five.

Arthropoda.—"The Maturation of the Ovum in the Cape and New Zealand species of Peripatus," forms the subject of Miss Lilian Sheldon's contribution to the *Quar. Jour. Microp. Soc.*, XXX., pt. I.

Petrarca bathyactidis is the title given by Mr. H. Fowler to the curious crustacean parasite described by him in the *Quart. Jour. Microp. Soc.* XXX., pt. 2. It is a member of that family of crustacean parasites upon Anthozoa of which the only other species known are the *Laura gerardiæ* of Lacaze-Duthiers, and the *Synagoga mira* of Norman. The specimens were all found in the mesenteric chambers of a single *Bathyactis symmetrica* from a depth of 2300 fathoms. It seems to be an internal commensal rather than a parasite. Mr. Fowler accepts for the group the title of Ascothoracida, suggested by Lacaze-Duthiers, and states that the characters are markedly shared between the Cirripedia and the Ostracoda.

Mr. M. Narayanan, of the Biological Laboratory of Madras, furnishes figures of the external sexual organs of *Scorpio fulvipes*, which is common at Madras, and shows that the division into two parts of the genital operculum is, in this species at least, a sexual character peculiar to the male. In this species the chelæ are narrower than those of the female, but this character is not universal.

One of the most extensive entomological collections that have been made of recent years is that of Herr Frühstorfer, who has visited Ceylon in the interest of certain German museums, and, with the aid of fourteen other collectors, has now at least 25,000 coleoptera, 7000 lepidoptera, 3000 orthoptera, at least as many dragon-flies, a thousand arachnids, and a good collection of snakes of all kinds.

Mollusca.—M. Bouchon Brandely has recently inspected some of the oyster-beds of the north of France, and reports much reckless fishing. On the river Roma, near St. Malo, the industry is almost ruined; at the Bay of St. Brieac the beds have been destroyed by the

reckless use of the dredge, and at Trequir, where the beds produce the famous Breton oyster, the fishermen, spite of all official warning, have fished to excess. Everywhere the rapacity of the dredgers and the constant disturbance of the young shells has caused a decline in the Breton oyster-beds.

Dr. E. V. Marteus describes the molluecs of Greece, collected by E. V. Ortzen. A sketch map accompanies the article, some new species are admitted, and a chart shows specific distribution. Three plates accompany the memoir.

Pisces.—Volume XXX. of the Challenger Reports also contains Dr. A. Gunther's third and concluding Report on the Fishes, the other reports being Volume I., on the shore fishes, and Volume XXII., on the deep-sea fishes. The species here contained are pelagic or ocean surface fishes, and six new forms are described. Many specimens were too immature for determination. The pelagic faunæ not only consist of truly pelagic fishes, but of deep-sea fishes which have the power of ascending to the surface, and of young and undeveloped littoral fishes driven out by currents. Forty-seven pages and six plates.

Reptilia.—A catalogue of the Chelonians, Rhyncocephalians and Crocodiles of the British Museum has been put forth by G. A. Boulenger, and is criticised by Mr. Lydekker in *Nature* of May 2. The family Crocodilidæ is made the type of a super-family Emydosauria, and though Hatteria and Sphargis are replaced on account of priority by Sphenodon and Dermochelys, the families containing these forms bear the names of Hatteriidæ and Sphargidæ. The Crocodiles are divided into two genera, Crocodilus and Osteolæmus, according to the presence or absence of a forward prolongation of the nasals to divide the anterior nares; and a similar feature is made use of to separate Alligator and Caiman. The Cryptodira are made into six families, but while the Emydidæ and four other families of Gray's Hand-list are included in the Testudinidæ, Staurotypus and Dermatemys are made into the family Dermatemyidæ, and Cinosternum and Platysternum are also erected into families. Testudo includes no less than forty-one species. Only four kinds of Chelonidæ or true turtles are recognized, two species of Chelone, and two of Thalassochelys.

The aquatic Carettochelys of New Guinea, which has no epidermal shields on the shell, is formed into a family.

Mammalia.—*The Archiv für Naturgeschichte* for 1887, issued August, 1889, contains lists of the publications relating to mamma-

logy in 1886, also those relating to ornithology for the same year (Ant. Reichenow). Dr. O. Boettger gives the herpetological works of 1886; Dr. F. Hilgendorf the ichthyological, and Drs. G. Pfeffer and W. Kobett the malacological.

Captain Fielden of the English army has discovered that the African monkey *Cercopithcius callitrichus* has become wild in the island of Barbadoes, W. I.

EMBRYOLOGY.

Extra-Ovarian Primordial Ova in the Human Embryo.—Dr. W. Nagel[1] reports the discovery of primordial ova in the strip of epithelium which is present on the outer side of the Wolffian body of human embryos. This discovery renders it pretty certain that the reproductive tissues were at one time much more extensively developed than in the present human species, probably in some premammalian type from which man and other mammalia, birds, reptiles and batrachia have descended. It is certain, at any rate, that the only living forms in which the reproductive or germinal tissue is developed throughout almost or quite the whole of the extent of the dorsal portion of the body cavity are some of the fishes. This discovery compares in importance and significance with that of Rathke made about forty years since, when that brilliant investigator announced the presence of branchial clefts during the early embryonic condition of all the higher vertebrates. Embryologists will await the publication of Dr. Nagel's completed studies upon extra-ovarian primordial ova with great interest.

Karyokinesis in Larval Amblystoma.—Last spring, through the kind offices of Miss Fanny R. M. Hitchcock, of New York City, the present writer came into the possession of a lot of the living ova

[1]Ueber das Vorkommen von Primordialeiern ausserhalb der Keimdrüsenanlage beim Menschen. *Anat. Anzeiger, IV.*, 1889, No. 16, pp. 496–498, 2 figs.

of a species of this genus of Urodele batrachians. They were placed in the aquaria of the biological school, and a goodly number were hatched out, but some of the ova were attacked by a unicellular green alga, which multiplied rapidly upon the zona radiata, and between the latter and its thick gelatinous covering, in a single layer. These algæ probably intercepted the oxygen. At any rate the embryos in all the eggs thus affected eventually died before their escape from the egg.

The embryos which had just hatched were found to be exceedingly interesting subjects in which to observe karyokinesis, or indirect cell-division. Nuclear spindles could be readily detected in all the tissues of the body in the greatest variety of stages. A few days after hatching the nuclear spindles became far less abundant and not so easily found. In sections of just-hatched embryos one could find nuclear spindles in all the tissues of the body, though most rarely in the muscles. They were particularly well-shown in the tissues of the brain, spinal cord, cranial ganglia; the prochondral tissue masses, from which the cartilaginous branchial bars are formed; in the blood corpuscles both in the vessels and heart; in the connective tissues, and in the epidermis, as well as even in the notochord. The epidermis of the young Triton or Salamander has been commended for the purpose of illustrating karyokinesis in the laboratory by European teachers of histology. It is, therefore, with much pleasure that I point out the occurrence of a type in this country which is tolerably abundant and accessible, which serves even a better purpose, as it illustrates the fact that karyokinesis is universal, or holds with respect to all of the tissues of the body during the early stages of development.

This type is also well adapted for the purposes of elementary teaching, in that the cells and muscle-fibres are very large, so that the spindles are likewise very large. The filaments of chromatin are also very large, thick and sharply defined, so that all of the phases of nuclear metamorphosis may be readily traced with moderate powers of the microscope.

The method of preparation which I found to serve my purpose very well was as follows: The embryos were killed and hardened with corrosive sublimate or Kleinenberg's picro-sulphuric acid. After hardening and thorough washing in repeated changes of weak alcohol, if corrosive sublimate is used, or in 70 to 80 per cent. alcohol if picro-sulphuric acid is used, the embryos are stained *in toto* in a dilute solution of hæmatoxylin; Kleinenberg's or Delafield's answers admirably, though even a simple saturated solution of extract of logwood in alcohol, saturated with potash alum, also gives good results, but not

so clear and fine as when one uses the best hæmatoxylin crystals. This last solution must be diluted with alcohol saturated with alum if over-staining is to be avoided. And if either of the preceding dyes, Kleinenberg's or Delafield's, is used, it should be diluted until the solution is not too opaque to read through if placed over print in a glass dish to the depth of one-quarter inch. In this the embryos may be left sixteen to twenty-four hours, or until they are dark purple.

The embryos may then be embedded in paraffine and sectioned lengthwise, and some in a vertical and others in a horizontal plane, as well as transversely and mounted serially in the usual way with the aid of a fixative. This gives a complete view of the organization of the larvæ, as well as a good opportunity to study the karyokinetic displays thus rendered visible by the hæmatoxylin. The chromatin threads are deeply stained by the dye and come out very sharply, and contrast with the rest of the substance of the cells.

The connective tissue which forms the cores of the branchial plumes is very interesting at this and later stages, as its cells are vesicular or form a meshwork tensely filled with fluid, which forms a supporting structure similar in function to the vesicular tissue of the axial notochord.

Around the connective tissue cores of the branchial plumes, and overlaid by the epidermis, the branchial vessels form a meshwork which is thus brought close to the surface for purposes of respiration. The tips of the tails of more advanced larvæ are attenuated for a short distance into an upwardly bent point which recalls the opisthure of some larval fishes, as well as the upward flexure of the notochord in those types where the phenomena of heterocercy are almost universal. This fact indicates that some of the types ancestral to the lower Batrachia may have been heterocercal.

The lateral sense organs in just-hatched larvæ are also conspicuous, and form two rows along the sides of the trunk and but one over the sides of the tail. Over the sides and top of the head they are more crowded together and never elongated as in *Amia*. On the inferior side of the head the rows of sense organs follow the direction of the now-closed branchial clefts; three curved rows of them may be made out on either side of the median line. In surface views a minute circular patch of pigment marks each sense organ, around which there is an annular colorless ring.—JOHN A. RYDER.

PHYSIOLOGY.[1]

Effects of stimulating nerve cells.—A full account of Hodge's work on this subject has recently appeared.[2] The results are highly interesting and important. The author's method was to stimulate for several hours (with regular periods of rest) the nerves attached to several of the spinal ganglia of the frog or the cat. The stimulated ganglion and a resting ganglion of the same animal were then excised and subjected to *identical treatment* in preparation for histological examination and comparison. Corrosive sublimate was the usual hardening reagent, and some or all of the components of Gaule's quadruple stain were used for staining. The chief results of the stimulation are:—

A. For the nucleus: 1. Marked decrease in size. 2. Change from a smooth and rounded to a jagged, irregular outline. 3. Loss of open reticular appearance with darker stain.

B. For the cell protoplasm: 1. Slight shrinkage in size. 2. Lessened power to stain or to reduce osmic acid. 3. Vacuolation.

C. For the cell capsule: Decrease in size of the nuclei.

The effects of the work are exhibited chiefly by the large cells, the small cells showing little or no change. Incidental observations on the connection of the cells and the fibres in the ganglia were made. Careful teasing of ganglia by means of a fine jet of water instead of needles showed that no apolar cells were present; typical bipolar cells and T-cells occur; other suggestive details were made out which are at present being investigated. Careful counting of the fibres of a posterior root and of the cells (*i.e.*, the nucleoli) in the corresponding ganglion showed the cells to be much more numerous—in the most careful count 1340 fibres and 4456 cells. This indicates a complex relation of the two within the ganglion.

Spinal ganglia.—The vexed question of the relation of the nerve fibres to the nerve cells in the spinal ganglia has been subjected to a new investigation by Gad and Joseph.[3] They employed the *ganglion iugulare* of the rabbit, which is attached to the vagus nerve outside the

[1] This Department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[2] *American Journal of Psychology*, May, 1889. For preliminary account see the same journal, May, 1888. Cf. also AMERICAN NATURALIST, April, 1889, p. 274.

[3] Du Bois Reymond's *Archiv*, 1889, p. 199.

skull. The central branch of this ganglion is of sufficient length to allow stimulation; the peripheral branch, the vagus nerve, has the great advantage that its functions are well known. The effects which cutting of the central and the peripheral branches and the consequent degeneration have upon both the structure and function of the nerve fibres of the vagus were studied, together with the time occupied by the passage of the nerve current through the ganglion. The authors feel justified in drawing the following conclusions from their work:—Most centripetal nerve paths are interrupted in the spinal ganglia by bipolar nerve cells. The function of these nerve cells is to exercise a trophic influence over the nerve fibres joining them. For the maintenance of the normal structure and function of centripetal nerve fibres connection with the spinal ganglia is necessary and sufficient. Every excitation wave of a centripetal nerve fibre must pass through a nerve cell in the spinal ganglion. Whether the difference of time in the reaction from stimulating peripherally and centrally from the ganglion is due to retardation of the nerve current in its passage through the ganglion, or to a special summation of subminimal stimuli there taking place, is uncertain. (The former time was .036 sec. longer than the latter, the centripetal fibres being stimulated and the reaction being the effect on the respiration movements.) The loss of function of both centripetal and centrifugal nerve fibres that have been separated from their trophic centres is fully developed in animals at the end of the second or the beginning of the third day. The vascularization of the spinal ganglia is sufficiently provided for by the vessels accompanying the nerve stems and nerve roots.

Voluntary impulses and inhibitions.—The nerve process originating in the gray matter of the central nervous system stands in a two-fold relation to muscular activity,—it either calls forth that activity or it puts a stop to it, it is either impulsive, motor, or it is inhibitory. What relation do these two varieties of the process bear to each other? Are they similar in nature? Are they similarly localized? Is their difference due to different directions of their wave motion? These questions and others have remained unanswered. Orschansky[4] thinks to throw light upon them by studying the time reactions of the two processes under various conditions. The masseter muscle was used, its great advantage being that, when the teeth are closed, the muscle can be made to contract and relax without the intervention of antagonistic muscles. Munk's idea that the impulse to relaxation of a muscle, *i.e.*, inhibition,

[4] *Archiv für Anat. und Phys.*, Physiol. Abtheil., 1889, p. 173.

is identical with the impulse to activity of its antagonist, was thus excluded. The subject of the experiment contracted or relaxed his masseter muscle upon feeling an electric stimulus upon the wrist, the movements with time curve being recorded upon a revolving drum. The results show practical equality in the two forms of will activity (*e.g.*, the contraction reaction time=.15 sec., the relaxation reaction time=.14 sec.), the slight differences being attributable to the method of experimentation. Exercise shortens both; increase of intensity of stimulus shortens both alike; both are similarly affected by alteration in the intensity and amplitude of the muscle contraction; alcohol at first shortens, then lengthens both; in short, the experiments argue against the dualistic theory of the two processes. If then voluntary impulses and inhibitions are physiologically identical, the anatomical localization of the interference of the two processes must be in the psychomotor centre. The effects of attention were studied, but have not yet been completely formulated.

PSYCHOLOGY.

History of the Owl, continued.—To the readers of the AMERICAN NATURALIST it may not be amiss to know something more of the final history of the two owls, the great horned and the barred, whose habits were described in the January number.

The lively disposition of the "bubo" increased as he grew older, and at times he would jump and fly about his room with a waggish air that was very amusing.

The Syrnium, on the contrary, became more sullen and morose, and seemed to be constantly in the "sulks" about something.

Their combined hootings at early dawn and twilight were music indeed to the ear of a naturalist. Cloudy days or an approaching storm would also excite the barred owl into uttering his peculiar notes; his mate not infrequently joining in the chorus.

One day in March, while driving on the prairie, I shot and winged a fine specimen of the American rough-legged hawk (*Archibuteo lagopus sanctijohannis*). Not having time that day to make a specimen of him, I put him for safe keeping in with the owls. The next morning, upon presenting myself at the door, I was greeted by a regular pandemonium of hoots and screeches, which at once struck me as presaging no good to my hawk, and, in fact, the latter was nowhere to be seen.

The peculiar actions of the bubo directed my attention to a dark corner of the building. Going through a peculiar "marking time" motion with his feet, swaying his body from side to side; his head revolving in a circle, he would look at me, and then peer into the corner. Going to this place I discovered my hawk, and a sorry specimen he was; tail pulled out, one wing gone, and presenting a generally dilapidated appearance. The miscreants had killed him, and then dropped his body behind a barrel in this corner. Lifting the body into view, the owls again broke out into excited hootings, saying as plainly as owl language could make it: "We are the fellows that did it." "We killed the bear."

It is well known that some of the hawks and kites will catch and devour reptiles.

One day while the owls were quietly eating their rations of Spoon river suckers, without any warning I threw on the floor beside them a large live pilot snake (*Coluber obsoletus*). The effect was magical, and almost threw them into owl hysterics.

They flew about the room, wildly uttering frightened hootings. The barred finally, much to my discomfiture, perched upon my shoulder, as if seeking my protection; his whole body was in a tremor, and he constantly uttered low, cat-like growls. Nor did their fright and excitement abate until the reptile was removed from their sight. Nor did they soon forget this trick, and for many days afterwards, on my entering their apartments, they would eye me sharply, as if suspicious that there were more snakes about me.

Being unusually busy for several days in early June, the owls were somewhat neglected, and did not receive their usual allowance of "bait." One morning the Syrnium was missing, and a search revealed the fact that he had been killed and eaten by his mate, the bubo, nothing being left of him to tell of his tragic end except the wings and one leg.

Soon after this I gave the great horned his liberty, but he seemed in no hurry to leave the old haunts. For several mornings in succession he would be returned to me by some one of my neighbors, saying that my "hooter" had got loose and was after their chickens; becoming impatient at these nightly raids, they handled him more roughly, and stones and sticks in no gentle hands were used to drive him from their premises. Not fancying this rough usage, he left the town, and I have good reason for believing took up his abode with a family of owls residing in a tract of woods two miles north of the village.—W. S. STRODE, *Bernadotte, Ill.*

ARCHÆOLOGY AND ETHNOLOGY.

Mound Explorations by W. K. Moorehead.[1]—MOUND NO. 36.—This mound is situated on high ground, overlooking the Scioto River, in Ross County, Ohio. We commenced work upon it March 21, 1889, by making a trench twenty-two feet wide on the smooth side, cutting entirely off that side. At a point about ten feet distant from the south edge we came upon a group of fifteen skeletons deposited in black earth on the original surface of the ground. They were not buried with any regularity. The mound above the skeletons was composed of yellow clay. It was with the greatest difficulty that we preserved two of the skulls entire. Near the south side of these bones, or where they commenced, was found a deposit of two hundred pottery fragments. When buried, the vessels which these fragments represent were evidently whole, but the pressure of the earth above had broken them into small pieces. To the west was found the skeleton of a child, tolerably well preserved. Above this was a layer of charcoal nearly a foot thick which extended northeast through the mound. All the other skeletons were placed about a foot below this. The charcoal was in pieces about as large as one's fist, and laid regularly, as if short logs had been thrown in and covered while burning.

There were no objects placed with these skeletons save in two instances. One skeleton situated in the centre of the mound had, between the thigh bones (femur), a number of objects; a stone tube in an unfinished condition, a slate ornament with two perforations, a banded slate ornament with one perforation, and a stone celt. Just above these, and laid in two rows, parallel with the bones, were ten flint arrowheads made of the black chalcedony found at Flint Ridge. These arrows were placed in two rows lying against the bones on each side. With another skeleton was found another deposit of the following objects, in the order in which they were found:

A large hematite celt, about four inches long, three inches wide, and weighing half a pound; a stone tube of steatite, five inches in length, with large perforation lengthwise drawn to a small aperture at one end (this is similar to those figured by Squier and Davis, who opened mounds in this neighborhood forty years ago); two beautiful leaf-shaped chalcedony spear-heads; above them was a celt and chisel of

[1]This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

greenstone. We continued down nearly ten feet further and were then at the centre of the mound. We found no more large deposits of objects. On the east side we found, on the base line, the skeleton of a child with three shell beads and two copper rings on the left hand. On the north side of the mound was found a layer of fine white ashes under the charcoal, then a small patch of burnt clay, but it was not regular enough to be called an altar. The wood of this charcoal was sufficiently well preserved to be recognized as white oak, hickory, poplar and chestnut.

There were no distinct layers in this mound, and no evidence of cremation. The charcoal had been placed there in a cold state, as the earth around it was not burned. Five men were employed two days in opening this mound.

MOUND NO. 37.—This mound is on the farm of Jesse James, three miles east of Chillicothe, Ohio, and situated on the third river terrace. Its dimensions are 50 x 76 x 13 feet. We began operations by starting a 22-feet trench on the east side, following the longest diameter of the mound. This was continued for fifty-nine feet, or until we were ten feet beyond the centre. Finding nothing of importance we stopped work. After we worked about twenty feet from the outer edge we came upon a bed of burnt bones and ashes three inches thick and extending eighteen feet toward the centre of the mound. We found by digging under the walls, on each side of our trench, that this layer ran further than the width of our trench. At about fifteen feet from the centre and on the base line of the mound was a skeleton, and 159 shell beads made from ocean shells. One hundred and two of these beads lay near the head, the rest near the lumbar vertebræ. The bones were too fragile to be preserved. Six feet from the base line and seven and a half feet from the summit, was a second skeleton in a better state of preservation. It lay above and to the west of the other skeleton.

The right femur lay with the lower articulate end far to the left. The tibia of the right leg lay in natural position, but the fibula lay far over to the left. The fibula of the left leg lay under the tibia of the left leg in an unnatural position, and both too much to the left.

ANATOMICAL PECULIARITIES.

1. Shoulder to shoulder measurement, 19 inches.
2. Head slightly crushed.
3. Lumbar vertebræ gone (in part).
4. Pelvis overlaps the hands.

6. Sacrum gone.
6. End of ulna nearly under the vertebræ (right ulna).
7. Right femur out of position.
8. Tibia and fibula of right and left legs out of position.
9. Not all the feet bones present.

Near the second skeleton was the skull of a panther, and at the west end of the trench, near the surface, we found the skull of a wolf. There were no relics whatever in this mound save the beads.

We had five men working six days.

MOUND No. 38.—This mound is on the farm of Mr. Till Porter, one quarter of a mile west of Frankfort, Ohio, and is nine feet high, and seventy by seventy-five feet in extent. Its greatest diameter is N. E. and S. W. We began work by opening a trench twenty-three feet in width on the south side; but Mr. Porter wishing the entire mound taken out, we engaged three teams and widened our trench so as to include all the mound except the northern part. The sides of this trench were irregular because we followed the "leads" of charcoal and ashes. It is in deposits of this nature that we find the skeletons. All our finds were on the east and south sides of the mound; nothing on the west side.

The ground on which this mound is built was cleared and leveled, and then burned. By keeping on this floor, shoveling was easy and the objects found without difficulty. At the base, and twelve feet from the outer edge, we came upon a mass of charcoal and animal bones. The latter were found at frequent intervals throughout the mound. For the next thirty feet the finds were unusually rich, and yielded us more skeletons and relics than any heretofore opened.

Two feet beyond the animal bones to the north, lay a skeleton with head to the south. It lay on the bottom of the mound, and was taken out in good condition. The shell and jaw found were intended to accompany this skeleton. On the same level lay another skeleton, much decayed, but which had, near its right hand, three copper buttons, a copper celt, and, above the head, a copper plate. The latter had an imprint of cloth upon it, and is similar to that figured by Foster in his work on Pre-historic Races of the United States. The metal coming in contact with the bones of the skull had colored them green. The bones and teeth indicated a person less than twenty-five years of age.

The next skeleton found lay on the base line, with its head toward the west. We took out all of its bones entire. No relics were found near it. Nearly all of these bodies were buried with the flesh on,

about seven feet from the centre, and at a point where the stratification showed to good advantage. The following enumeration of layers shows how the mound was put up:

IRREGULAR LAYERS.

A. Clay,	1 ft.	
B. Dark clay,		6 in.
C. Gravel,		6 in.
D. Clay,	1 ft.	
E. Coarse gravel,		4 in.
F. Clay,		8 in.
G. Patch of gravel, followed by a thin streak of clay, very irregular,		4 in.
H. Gravel,		6 in.
I. Coarse clay,	1 ft.	8 in.
K. Soft dark spots, of very irregular shapes, which held the skeletons and extended upwards one and one-half feet,	1 ft.	6 in.
Total,	8 ft.	

L. The altars found on each side, shown in the vertical section, and which extended upwards about one foot.

M. The burnt floor of the mound.

Near the centre of the mound was found a large skeleton, better preserved than most of the others, and which seemed to be the most important individual buried there. It lay on the base line, with head to the north. The head was about six inches higher than the feet, which were much decayed. About six inches from the extremities of the left foot we found a large copper plate, with a print of wood on one side, and coarse cloth on the other. This plate was thirteen by seven inches, and its weight over a pound, and was probably the largest ever taken from a mound in this country. Near the right femur were found twenty-two pearl beads, and at the shoulder eight large bear teeth. Three copper buttons lay against one of these bear teeth and had colored it green. At the neck of this individual we took out five hundred and eighty-four pearl beads, large and small. These were well preserved, and, but that each one had been perforated, their commercial value would be several thousand dollars.

Eight feet west of this last body, and in a little hollow, supported by burnt stones, was an altar of large size and regular outline. This altar is identical with those figured by Squier and Davis, in Vol. I. of

"Smithsonian Contributions to Knowledge." Altars have been occasionally found in the mounds, but there has never been but one taken out entire. This altar has a broad rim extending around it eight inches wide. The central depression is four inches deep, twenty inches long, twelve inches wide; making the total length thirty-six inches.

On the east side of the mound, in the gravel layer, five feet from the summit and three feet from the base line, were found three copper celts and seven copper ear-rings. With these were three human ribs. The copper was in three rows; the celts in the lowest row, four of the brooches in the second row, and three in the third row. Three more skeletons were found on the base line just north of this copper, but they had nothing with them.

Northeast of this last deposit is a spot of dark earth, which contained the ashes and calcined bones of six cremated individuals. With five of these copper had been buried, but the heat of the fire had melted it. Though damaged by heat, I obtained one celt, two large plates, eleven copper beads, and a cracked clay pipe. The burned bodies occupied spaces ranging from sixteen to twenty-four inches. A pipe, cracked by the heat, was found with the copper celt.

With the next skeleton found was a small copper celt, unhurt by the fire, which showed traces of both cloth and wood. The skeleton lay with head to the north on the base line, and was not very well preserved. Two more decayed skeletons were found which had copper buttons placed with them. They were placed with heads to the south and on the base line of the mound.

In the centre of this mound nothing whatever was found. Twelve feet from the centre, to the west, were two cremated bodies which had broken flint arrow-heads buried with them. To the north of these was a small, irregular altar. In this altar was a small black thornpipe, said by Squier and Davis to be the true mound pipe. Ten feet eastward was a small pit, with nicely squared edges, eight inches deep, twelve inches long, and ten inches wide, containing the skeleton of a child. The bones were well preserved, and with them were two perforated panther teeth. We found the bones of three more individuals in this mound. They were a little northeast of the small pit last mentioned, but nothing whatever was found with them. One of the skulls was saved whole. It is a very good representative of one of four types taken from this mound. One of these three skeletons was placed in a shallow pit, and near the group was an irregular mass of hard-burned clay beveled and without depression. It could not therefore have been an altar.

This mound was seven days in being excavated, and six men were employed. It was hauled out by three teams and dumped in a gravel pit at the owner's request, so that it is now only three feet high, whereas it used to be over nine.

MICROSCOPY.

On a method of preparing blastoderms of the Fowl.—Hasnell (*Proc. Linn. Socy. New South Wales, 1889*) has found the following method of great value in expediting the process of removing and preparing the blastoderms of early stages (up to the third day), and also in diminishing the risk of injury. The fixing fluid used is ten per cent. nitric acid, as employed by Whitman and others. The novel point in the method is the mode of getting rid of the entire white without any trouble, and without risk of damaging the blastoderm.

An ordinary *conical* measuring glass of a capacity of 100 c.c., with the edge turned out with a large "lip," is placed in a flat dish, and is filled to the very brim with nitric acid. The egg shell is then broken, and the entire contents poured into the glass in exactly the method adopted in the kitchen, except that the egg is held when being opened close over the glass so that there may be as little disturbance as possible. The glass being brim full, when the contents of the egg are added to it a quantity of the fluid runs over the sides; with this there begins to run some of the external, more fluid, part of the white; as this runs over, it by its weight gently draws the firmer part of the white with it, and finally the firm layer which immediately invests the yolk is peeled off as one might peel off the outermost coat of an onion, leaving the yolk and blastoderm with the investing vitelline membrane quite entire and perfectly clean in the glass—the entire white having in this way spontaneously thrown itself off. The whole process takes only two or three seconds. If, as occasionally happens, owing to some of the fluid having been splashed out of the glass in pouring in the egg, the white does not begin to run over the edge, a little of it should be pushed over the lip, and left to draw the rest after it in the manner described.

The entire yolk with the blastoderm should be left for half an hour in the glass with the nitric acid; it may then, part of the acid having been poured off, be returned into a large dish full of water, which has to be changed several times. After the yolk has been for a few minutes in the water the blastoderm has to be cut out with scissors, when it will readily peel off from the underlying yolk, and the vitelline membrane readily comes away. The blastoderm is then to be left for half an hour in water, which should be renewed, and then transferred to weak alcohol (60 per cent.), in which it should remain for twelve hours; it should then be placed for two days in 90 per cent. alcohol, and then stained by immersion for three or four hours in Ehrlich's hæmatoxylin (crystallized hæmatoxylin 2 grms., water 100 c.c., glycerine 100 c.c., acetic acid 10 c.c.), followed for a few minutes by acidulated alcohol (97 c.c. 70 per cent. alcohol, 3 c.c. hydrochloric acid), and that in turn for half an hour or more by alcohol diluted to 70 per cent. by the addition of ordinary tap-water or water artificially rendered slightly alkaline. The specimen will then be ready, after passing through 90 per cent. and absolute alcohol, for mounting as a whole. For sections it is better to omit the acidulated alcohol, and to allow the specimen three days further hardening in 90 per cent. and absolute alcohol.

The important point here is, of course, the ease and rapidity with which the white is got rid of, so that a large number of blastoderms may be prepared in a comparatively short time. But the mode of subsequent treatment described above, which is applicable to blastoderms prepared in other ways, gives results, particularly for whole blastoderms, such as are not obtained by any other of the many methods tried.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Association for the Advancement of Science.—The 38th meeting of the A. A. A. S. was held at Toronto, Ontario, from August 17th to September 3d, 1889. There were 421 members registered; 190 new members were elected; and 72 names were added to the list of fellows. The meeting was remarkable for the number of Past Presidents in attendance, these embracing Professors Dana, Hall, Newberry, Barker, Dawson, Newton and Morse. The retiring President, Major J. W. Powell, was absent, and his address upon "The Evolution of Music" was read on Wednesday evening, August 28th, by Mr. G. K. Gilbert, of the U. S. Geological Survey. The vice-presidents were all on hand except Prof. Arthur Beardsley, of Section D, and the Secretary of that section, James D. Denton, was elected to preside in his stead. The subjects of the vice-presidents' addresses were as follows:

Section A.—Mathematics and Astronomy:—"Mathematical Theories of the Earth," by R. D. Woodward.

Section B.—Physics:—"A Review of Theories of Electrical Action," by H. S. Carhart.

Section C.—Chemistry:—"The Nature of Amalgams," by William L. Dudley.

Section E.—Geology and Geography:—"The North American Mesozoic," by Chas. A. White.

Section F.—Biology:—"The Protoplasm of Organisms," by George L. Goodale.

Section H.—Anthropology:—"The Israelites and the Indians," by Garrick Mallery.

Section I.—Economic Science and Statistics:—"Economic and Sociologic relations of Canada and the United States, prospectively considered," by Chas. S. Hill.

Of these addresses, that of the vice-president of Section I received an extended notice by the Toronto *Mail*. The editor naturally disagreed with Prof. Hill on many points, more especially in regard to the effect of protection on the cost of manufactured goods. The following is a list of the papers entered to be read before the various sections. Some were only read by title because of the absence of the authors.

SECTION A.

The New Dearborn Observatory.—10 min.—By G. W. Hough.

Astronomical Observations made with the Great Telescope of the Lick Observatory since June, 1888.—25 min.—By Edward S. Holden.

A Desideratum in the Presentation of Mathematical Truth.—5 min. —By Charles H. Chandler.

Automatic Photographic Transits.—15 min.—By Frank H. Bigelow.

A Method of Finding Factors.—10 min.—By James D. Warner.

On the Graduation of Meridian Circles *in situ*.—10 min.—By Wm. A. Rogers.

On the Use of a Floating Mirror as an Auxiliary to a Meridian Circle.—12 min.—By G. C. Comstock.

The Relation Between Stellar Magnitudes, Distances, and Motions, —15 min.—By J. R. Eastman.

On the Proper Motions of the Stars in the Harvard College Observatory Zone, between the limits 50° and 55° Declination.—8 min.— By Wm. A. Rogers.

Formula for the Probability of any Fact or Occurrence about which any Number of Witnesses Testify.—10 min.—By J. E. Hendrick.

On the Solar Parallax and its related Constants.—30 min.—By Wm. Harkness.

Double Star Discoveries and Measures made at the Lick Observatory, August 1st, 1888, to August 1st, 1889.—10 min.—By D. W. Burnham.

A proposed Catalogue of Declinations.—45 min.—By Henry Farquhar.

The Solar Corona, a phenomenon in Spherical Harmonics.—5 min. —By Frank H. Bigelow.

On the Automatic Eclipsograph.—15 min.—By David P. Todd.

Errors in Star Catalogues.—15 min.—By E. Frisby.

The Peruvian Arc.—30 min.—By E. D. Preston.

New Arrangement for an Astigmatic Eye-piece.—3 min.—By J. A. Brashear.

The Jena Optical Glass.—5 min.—By J. A. Brashear.

The Centrifugal Catenary.—15 min.—By J. Burkitt Webb.

The Polar Tractrix.—10 min.—By J. Burkitt Webb.

A Precession Model.—10 min.—By J. Burkitt Webb.

The Hastings Achromatic Objective.—5 min.—By J. A. Brashear.

Annual Parallax of South 503.—4 min.—By F. P. Leavenworth.

SECTION B.

Exhibition of a new Spectroscope Slit.—3 min.—By Romyn Hitchcock.

Exhibition of a Thermometer with constant Zero Point.—3 min.—By Romyn Hitchcock.

The Measurement of Magnification in the Microscope.—15 min.—By W. Le Conte Stephens.

Concerning Thermometers.—20 min.—By Wm. A. Rogers and R. S. Woodward.

Experimental Proof of Newton's Law of Cooling.—8 min.—By Wm. A. Rogers.

On the Partition of the Mean Kinetic Energy of a perfect gas between the rotary and translatory motions of its molecules.—8 min.—By H. T. Eddy.

Note on the Magnetic Rotation of Polarized Light according to the Electro-magnetic Theory.—10 min.—By H. T. Eddy.

Researches on Sonorus Sand in the Peninsula of Sinai (with lantern views).—By H. Carrington Bolton.

Relative Merits of Dynamometric and Magnetic Methods of Obtaining Absolute Measurements of Electric Currents.—30 min.—by Thos. Gray.

A Quadrant Electrometer.—5 min.—By Harris J. Ryan.

Magnetic Leakage in Dynamos.—10 min.—by H. S. Carhart.

An Improved Standard Clark Cell with Low Temperature Co-efficient.—15 min.—By H. S. Carhart.

On Globular Lightning.—By T. C. Mendenhall.

A Preliminary Report on the Influence of Temperature upon the Color of Pigments.—15 min.—By Edward L. Nichols and B. W. Snow.

The Solar Condition upon which the Aurora Depends.—5 min.—By M. A. Veeder.

The Determination of the Amount of Rainfall.—12 min.—By Cleveland Abbe.

The Hydro-Electric Effect of Stretching Metals.—15 min.—By Carl Barus.

Additional Experimental Proof of the Constancy of the Relative Co-efficients of Expansion between Jessop's Steel and Bronze, between the limits of minus 5° and 95° Fahr.—5 min.—By Wm. A. Rogers.

Experiments in Duplex Telephony in 1883.—5 min.—By A. M. Roseburgh.

Recent Progress in Storage Batteries.—10 min.—By George F. Barker.

A Mode of Suspension for Foucault's Pendulum.—5 min.—By R. B. Fulton.

A Modification of the "Pascal's Vase" Experiment.—3 min.—By A. L. Arey.

Experiments for Demonstrating that the force of a Detonating Explosion is exerted in all directions about the explosive center.—5 min. —By C. E. Monroe.

Effects of Electrostatic Discharges on Photographic Plates.—10 min.—By Thomas French, Jr.

A Meuntain Study of the Spectrum of Aqueous Vapor.—25 min.—By Charles S. Cook.

An Exhibition of Photographs, taken in 1864, of the Living Eye (*a*) The retinal vessels; (*b*) The retinal inverted image of an object placed in front of the eye.—8 min.—By A. M. Roseburgh.

An Exhibition of Photographs of the Fundus of the Eye of the Cat taken while under the influence of Chloroform.—5 min.—By A. M. Roseburgh.

Experimental Determination of the Periodic Pulsations of a Thermometer made of the new "Jena" glass.—By Wm. A. Rogers and J. B. Webb.

SECTION C.

Dynamical Theory of Albuminoid Ammonia.—50 min.—By Robert B. Warder.

Molugrams and Molugram Liters.—2 min.—By Chas. E. Monroe.

The Explosiveness of the Celluloids.—10 min.—By Chas. E. Monroe.

The Chemical Composition of the Mica Group.—40 min.—By F. W. Clarke.

Spectrum Photography.—40 min.—By R. Hitchcock.

New Bottle for Hydrofluoric Acid.—5 min.—By Edward Hart.

Some Peculiarities of Butter.—20 min.—By H. W. Wiley.

Composition of the Seed of *Calicanthus glaucus* (Illustrated).—20 min.—H. W. Wiley.

The Action of Light on Silver Chloride.—10 min.—R. Hitchcock.

A Method of Mounting Photographic Prints on Paper.—5 min.—R. Hitchcock.

Some Notes on the Estimation of Nitrogen by the Kjeldahl Method. —10 min.—M. A. Scovell.

Succinylo-succinic Acid.—15 min.—Adolph Bayer, Munich, Germany, and A. W. Noyes.

Estimation of Bromine in Presence of Chlorine.—10 min.—Albert B. Prescott.

On the Acquisition of Atmospheric Nitrogen by Plants.—20 min.—W. O. Atwater.

Discussion of the Report of Committee on the Formation of a National Chemical Society.

Food Preparation.—10 min.—By Fred. Hoffman.

The Composition of Ontario Oats.—10 min.—By C. C. James.

Jadeite and Nephrite.—15 min.—By L. P. Kinnicutt.

Continuation of the Discussion upon the Report of the Committee upon the Spelling and Pronunciation of Chemical Terms.

SECTION D.

Results of Recent Experiments to Determine the Resistance of Air to Inclined Planes in Motion, with applications to the problems of Soaring Pigeons.—20 min.—By O. Chanute.

Experimental Comparison of the Performance of Steam Injectors *vs.* a Duplex Steam Pump.—35 min.—By E. B. Perry.

On the Preservation of Timber.—15 min.—By O. Chanute.

On the Relative Economy of Modern Air Compressors. Illustrations by Lantern.—40 min.—By J. E. Denton.

Note on Performance of a Pumping Engine.—10 min.—By M. E. Cooley.

New Device for Autographic Registry of Extension in Tension Tests.—15 min.—By Thos. Gray.

Notes on Anti-friction Construction for Revolving Mechanism for Observatory Domes.—10 min.—By W. R. Warner.

Note on Performance of a Vibrating Piston Engine.—10 min.—By M. E. Cooley.

Probable Principal Cause of Superior Economy of Multiple Expansion Engines.—10 min.—By J. E. Denton.

Exhibition of a Novel Motor.

SECTION E.

Topographic Types of Northeastern Iowa.—25 min.—By W. J. McGee.

The Lake Ridges of Ohio and their Probable Relations to the Lines of Glacial Drainage into the Valley of the Susquehanna.—30 min.—By G. F. Wright.

The Moraines of the Wabash–Erie region. The Irondequoit Glacier.—15 min.—By C. R. Dryer.

Glacial Phenomena of Northern Indiana and Northeastern Illinois.—20 min.—By Frank Leverett.

The Attractive Scenery of our own Land.—20 min.—By A. S. Bickmore.

The Mastodon of Kent and What We Know About It.—20 min.—By Ed. Jones, Esq.

On Certain Remarkable New Fossil Plants from the Erian and Carboniferous, and on the Characters and Affinities of the Paleozoic Gymnosperms.—20 min.—By Sir Wm. Dawson.

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